Issued March 1958

SOIL SURVEY

Nicollet County Minnesota

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
UNIVERSITY OF MINNESOTA AGRICULTURAL EXPERIMENT STATION

How to Use THE SOIL SURVEY REPORT

THIS report is about the soils of Nicollet County, Minnesota. It describes each kind of soil in the county and tells how you can use it, how to take care of it, and what yields you can expect. The soil map shows the location and extent of each kind of soil.

Soils of a farm

If you are a farmer, or if you work with farmers, you probably want to know about the soils of a farm or small tract. First find the right place on the soil map. The map shows township and section lines, towns and villages, roads, streams, most of the houses in rural areas, and other landmarks. Remember that 2 inches on the map is 1 mile on the ground.

Each kind of soil is marked on the map by a symbol made up of two letters; for example, the symbol CB identifies Clarion silt loam, undulating phase. On the legend sheet that accompanies the soil map are printed the names of all the soils mapped in Nicollet County, the symbols that identify them, and the color in which each is shown on the map. Look up the symbols in the map legend to find the names of your soils. Then you can refer to the soil description in the report. Yields that you can expect from common crops are shown in table 5.

Soils of the county

If you are interested in general land use planning, for instance in the location of highways or in the selection of industrial sites or of areas to be set aside for recreation, you will want, besides information about specific soils, general data about the county as a whole.

The first five pages give you information about the climate; about towns, roads, and railroads; about available water; and about types and sizes of farms, farm tenure, and principal farm products and how they are marketed.

Soil scientists interested in the origin and composition of the soils will find in the section Soil Development and Classification a brief technical discussion of the soils and the processes that produced them.

Cooperative contribution from—
SOIL CONSERVATION SERVICE
and
UNIVERSITY OF MINNESOTA AGRICULTURAL EXPERIMENT STATION

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SOIL SURVEY OF NICOLLET COUNTY, MINNESOTA

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Contents

[1] Field work was done while Soil Survey was part of Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture. It was transferred to the Soil Conservation Service on November 15, 1952.

NICOLLET COUNTY is in a fertile prairie area well suited to growing corn, small grains, hay, and other forage crops. The county is predominantly rural. Livestock raising is the major agricultural enterprise. To provide a basis for the best agricultural uses of the land, this cooperative soil survey was made by the United States Department of Agriculture and the University of Minnesota Agricultural Experiment Station. Field work for the survey was completed in 1948. Except where otherwise specifically indicated, statements in this report refer to conditions in the county at the time of survey.

General Nature of the Area

Location and extent

Nicollet County is in the south-central part of Minnesota (fig. 1). The county is a triangular area bounded on the north by Sibley County, and on the east and southwest by the Minnesota River. St. Peter, the county seat, is in the east-central part.

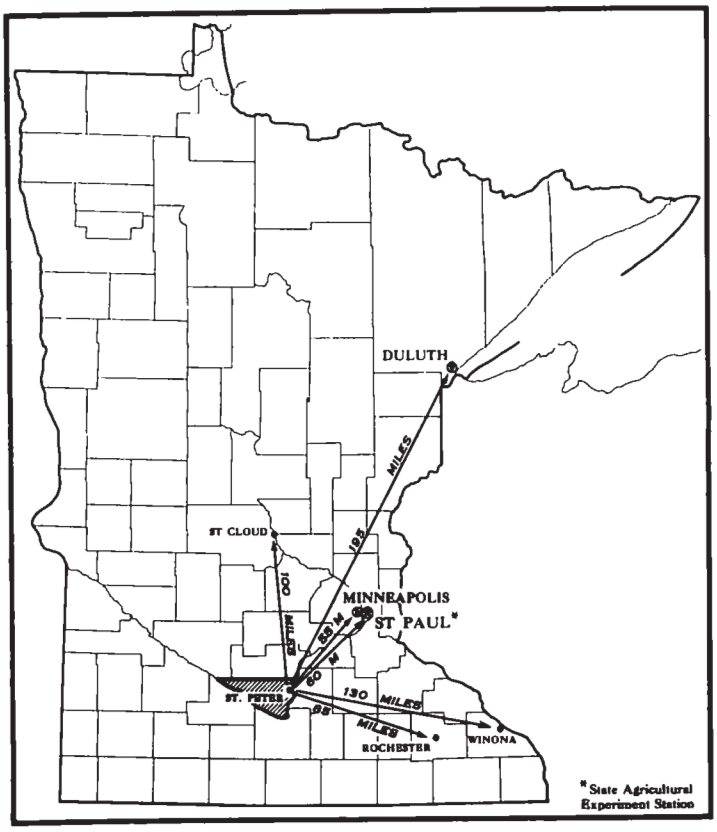

FIGURE 1.—Location of Nicollet County in Minnesota.

Physiography, relief, and drainage

Nicollet County lies in the Western Young Drift section of the Central Lowland province.

The county is covered by a mantle of glacial drift, varying in thickness from less than 100 feet near Courtland to more than 400 feet near Bernadotte. The glacial drift is composed of silty and clayey calcareous material, mixed with boulders, cobblestones, gravel, and sand, in varying proportions. The gently rolling terrain, with many small depressions, marshes, swales, and low, nearly level areas, is characteristic of a young glacial till plain.

Bedrock underlies the till, and outcrops in places along the Minnesota River. Between North Mankato and St. Peter and northward it appears along the break between the upland and the river bottoms. Because most of the till contains a high proportion of silt and clay, it has a moderately high water-holding capacity and is plastic and sticky when wet. In a few scattered areas, water from the melting glaciers washed out most of the fine soil particles and left gravelly or sandy knobs. The largest such area is northwest of Swan Lake.

The topography of Nicollet County is varied. Very steep bluffs separate the bottom lands of the Minnesota River and its tributaries from the nearly level uplands. In some places these bluffs consist entirely of glacial material, in other places they are partly limestone or sandstone outcrops. Except for this more or less continuous strip along the Minnesota River, the county is nearly level or gently undulating. Elevations above sea level range from 754 to 1,010 feet.

The county is drained by the Minnesota River and its few small tributaries. Some of the small creeks that drain the county have meandering shallow courses near their headwaters but fall into rather deep ravines within 2 or 3 miles of the Minnesota River. Rush River, flowing into the Minnesota River at the village of Henderson in Sibley County, provides some drainage for the northern part of Nicollet County. The county has a few shallow lakes, the largest of which is Swan Lake, between Courtland and Nicollet.

Climate

Nicollet County has a subhumid continental climate. Summers are warm and winters moderately cold. The data in table 1 are compiled from the records of the United States Weather Bureau station at St. Peter.

The average temperature for the winter months is 17.5° F., and for the summer months 70.7° F. The highest recorded summer temperature is 109° F., and the lowest winter temperature, —40° F. Summer days are usually warm, and because humidity is often high, many nights are

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at St. Peter, Nicollet County, Minn.*

[ELEVATION, 825 FEET]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1889)	Wettest year (1951)	Average snowfall
	F.	*F.*	*F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	20.2	67	−31	0.85	2.06	2.16	7.0
January	14.7	65	−40	.88	.90	.64	8.3
February	17.7	68	−36	.70	.48	1.95	6.5
Winter	17.5	68	−40	2.43	3.44	4.75	21.8
March	31.7	84	−30	1.27	1.03	3.34	7.9
April	47.2	92	−5	2.21	1.14	2.37	1.8
May	58.7	107	21	3.32	1.48	3.39	.1
Spring	45.9	107	−30	6.80	3.65	9.10	9.8
June	68.3	104	32	4.71	2.95	7.75	0
July	73.0	109	34	3.40	2.33	4.15	0
August	70.8	104	34	3.46	2.24	7.58	0
Summer	70.7	109	32	11.57	7.52	19.48	0
September	62.6	103	21	3.42	.54	3.89	[3]
October	50.2	90	4	2.19	.12	1.47	.3
November	33.9	77	−22	1.29	1.28	1.92	4.3
Fall	48.9	103	−22	6.90	1.94	7.28	4.6
Year	45.8	109	−40	27.70	16.55	40.61	36.2

[1] Average temperature based on a 60-year record, through 1954; highest and lowest temperatures on a 56-year record, through 1952.
[2] Average precipitation based on a 65-year record, through 1954; wettest and driest years based on a 61-year record, through 1954; snowfall based on a 55-year record, through 1954.
[3] Trace.

warm. The frost-free season extends, on the average, for 140 days from May 11 to September 28. Killing frosts have, however, occurred as late as June 22 and as early as September 10. The average grazing season is about 160 days, from May 10 to October 15.

The average annual rainfall for the county is 27.70 inches, of which 18.31 inches, or 66 percent, falls in the months from May through September. Only 2.43 inches, or 9 percent of the average total precipitation, falls during the months of December, January, and February. Most of the precipitation at this time is snow. Severe droughts are infrequent, but occasionally crop yields are reduced by short periods of hot, dry weather. Although much of the rain falls slowly and steadily, thunderstorms with intense rainfall are common during summer.

Water supply

Water for household use is obtained mostly from drilled wells, many of which are more than 100 feet deep. Springs along the bluffs of the Minnesota River supply some water for nearby farms. Nearly every farm has a windmill, a gasoline engine, or an electric motor for pumping water. As rural electrification expands, electric motors are rapidly becoming the most common source of power for pumping. Intermittent streams or lakes supply water for livestock part of the time.

Vegetation

Nearly all of Nicollet County was originally covered with tall grasses. The rough broken land along the Minnesota River is wooded, and in some places, particularly along the small tributaries, the woods extend 2 or 3 miles back from the river. The only sizable area of upland that had a forest cover lies between Norseland and Traverse, in the northeastern part of the county. Smaller wooded areas surrounded some of the lakes. The predominant trees are basswood, maple, elm, oak, and ash. The most important native grasses on the prairie were big bluestem, bluejoint, cordgrass, Indiangrass, and switchgrass.

Wildlife

Wildlife was abundant when the area was first settled but as settlement spread, the wild game gradually disappeared. Now, migratory waterfowl, pheasants, and gray or fox squirrels are the principal game. The lakes in the county are not especially good for fishing. A few small game refuges have been established.

Organization and population

Settlement of Nicollet County began in 1851, soon after the signing of a treaty between the Federal Government and the Sioux Indians. The county was organized in

1853. It was named for Joseph Nicollet, an early explorer of the area.

Skirmishes with the Indians continued until 1862, when there occurred a serious uprising, in the course of which many settlers were killed and the settlement of New Ulm, in Brown County, was destroyed. After this attack was put down, the county developed rapidly.

In 1950 the population of the county was 20,929. The largest town was St. Peter with 7,754 inhabitants. North Mankato had 4,788; Nicollet, 493; Lafayette, 438; and Courtland, 251.

Industries

The majority of the people in the county are engaged in some form of agriculture. No large industries compete with farming for labor. A few small nonfarm industries, such as cement block plants, gravel plants, and hybrid seed companies, operate in St. Peter and North Mankato.

Transportation, utilities, and services

The early settlers hauled grain and other products by wagon to nearby loading points on the Minnesota River. River boats and barges then carried the produce to Minneapolis and St. Paul markets. River traffic ended when railroads were built in the county.

At present, the Chicago and Northwestern Railway connects St. Peter, Traverse, Nicollet, and Courtland, in Nicollet County, and New Ulm, in Brown County. Crossing the county from north to south is a line of the Minneapolis and St. Louis Railway. It connects Lafayette, Klossner, and New Ulm. Two lines of the Chicago and Northwestern Railway that do not enter the county supplement transportation services in the county. One line, connecting St. Paul with Omaha, Nebr., passes through Mankato, just across the Minnesota River from North Mankato. Another line that joins Mankato and New Ulm serves the western part of Nicollet County.

United States Highway No. 14 crosses the southern part of the county, from North Mankato through Nicollet, to the west border of the county near New Ulm. St. Peter, near the eastern boundary of the county, is on United States Highway 169, which cuts through the northeastern corner of the county. Other towns and villages are connected by State highways 4, 15, 22, and 111. Graded and graveled county and township roads, most of them well maintained, provide outlets for the rural sections.

The county is well equipped with electricity and telephones. In 1950, 1,446 of the 1,535 farms had electricity available and 1,140 had telephones. Schools and churches are conveniently located throughout the county. Daily mail delivery service is provided.

TABLE 2.—*Livestock on farms in Nicollet County, Minn., in stated years*

[Livestock of all ages except as otherwise indicated by footnotes]

Livestock	1930	1940	1950
	Number	*Number*	*Number*
Horses	7,952	6,742	2,458
Mules	116	80	16
Cattle	30,196	32,329	29,480
Swine	57,369	32,247	59,219
Sheep	4,746	4,815	3,702
Chickens	[1] 227,447	[2] 240,450	[2] 336,427
Turkeys	[3] 6,766	[3] 14,486	[3] 14,154

[1] Three months old or more at time of census.
[2] Four months old or more at time of census.
[3] Raised in year preceding census.

Agriculture

Practically all of Nicollet County is agricultural. Livestock raising is the most common agricultural activity. The soils are well suited to the forage crops needed for livestock farming.

Livestock

More farms in Nicollet County are engaged in livestock raising than in any other one type of agriculture. The livestock population of the county for stated years is given in table 2. In 1950 there were 29,480 head of cattle in the county. Holstein-Fresian was the predominant breed, followed by Guernsey, milking Shorthorn, and Brown Swiss. Some feeder cattle are bought in early fall, to be fattened for market. On almost every farm, hogs are raised; on some farms, more than 100 each year. In 1950 there were 59,219 hogs in the county. There were 336,427 chickens on the farms in 1950.

Nearly all livestock marketed is trucked to South St. Paul, the principal livestock marketing center in Minnesota. Milk is sold to creameries and milk depots as whole milk. Some creameries manufacture butter and cheese.

Crops

During the last 30 years substantial shifts in the acreage of major crops has taken place (see table 3). The acreage of corn, the most important crop, increased from 53,544 in 1929 to 74,043 in 1949. Soybeans, grown on only 24 acres in 1929, have since become an important oil-seed crop. In 1949, there were 16,251 acres in soybeans. Oats, now the most important small grain, increased from 27,516 acres in 1929 to 45,700 acres in 1949. Spring wheat, before 1929 the principal small grain, was planted on only 1,941 acres in 1949. Sweet corn, green peas, and other canning crops are important sources of cash income but occupy a comparatively small acreage.

Hay has always been an important crop. Alfalfa has become the major tame hay crop. The acreage in wild hay has decreased as more land has been drained and made suitable for cultivation. In some places tame grasses have been seeded on undrained land to improve the quality of the forage.

Planting and harvesting methods

Most of the farmers in Nicollet County practice good agricultural methods. Land that is to be seeded the following spring to small grain or corn is usually plowed in the fall, then left until it is dry enough in the spring for seedbed preparation. Small grains are sown as early as the weather permits, usually in middle or late April. The

grains ripen during middle or late July or early in August, depending upon growing conditions.

Corn for grain is usually planted between May 10 and May 25. Corn for silage is planted later and is ready for the silo in early September. Corn that is to be picked and cribbed stands in the field until its moisture content is so reduced that it can be safely stored. Some corn is hand-picked, but mechanical pickers are generally used. The warm, humid summers are particularly favorable for corn, but late-maturing varieties may be damaged by early fall frosts.

Alfalfa is usually harvested three times a year. The first cutting is made about the middle of June. Native wild grass is cut later in summer, and in unusually wet seasons, not until early fall. When harvest is delayed, the wild hay is usually low in nutritive value.

Land use and size of farms

In 1950, 270,083 acres, or 91.9 percent of the county, was in farms. The land in farms was distributed according to use as follows:

	Acres
Cropland harvested	189, 282
Cropland used for pasture	8, 419
Cropland neither harvested nor used for pasture	2, 164
Woodland	6, 453
Woodland pastured	12, 562
Permanent pasture (not woodland or cropland)	29, 058
House lots, roads, wasteland, etc	22, 145
Total land in farms	270, 083

Practically all of the woodland is on the bluffs bordering the Minnesota River bottoms. Much of the land used for permanent pasture is too wet to be cultivated.

The 1,535 farms in the county in 1950 were classified as follows:

	Number
General farms	505
Field crop farms (including 187 cash grain farms)	192
Livestock farms (other than dairy or poultry)	551
Dairy farms	109
Poultry farms	94
Vegetable farms	5
Unclassified farms	79
Total	1, 535

The 1,535 farms of the county averaged 175.9 acres in size in 1950. Classification of farms according to size was as follows:

	Number
Less than 3 acres	36
3 to 29 acres	81
30 to 99 acres	149
100 to 179 acres	602
180 to 259 acres	445
260 to 499 acres	210
More than 500 acres	12
Total	1, 535

Farm investment and farm tenancy

Nearly all of the farmers own tractors and other power equipment. Only a few depend entirely on horses, but many use a combination of horse and tractor power. According to the Federal census report for 1950, there were 2,163 tractors on 1,376 farms, and 744 motortrucks on 676 farms. There were 810 mechanical cornpickers on 805 farms, and 355 grain combines on 355 farms.

TABLE 3.—*Acreage of principal crops in Nicollet County, Minn., in stated years*

Crop	1929	1939	1949
	Acres	*Acres*	*Acres*
Corn, for all purposes	53, 544	54, 885	74, 043
Grain	43, 236	47, 048	65, 862
Silage	2, 751	5, 142	6, 356
Forage (cut for fodder, or grazed)	7, 557	2, 695	1, 825
Hay, total	40, 891	40, 307	27, 594
Timothy and clover, mixed or separate	5, 649	2, 382	1, 422
Alfalfa	7, 195	11, 044	10, 087
Small grain cut for hay	25	414	296
Annual legumes saved for hay	36	1, 049	[1] 241
Other tame hay	1, 085	8, 150	2, 575
Wild hay	26, 901	17, 268	12, 973
Small grain:			
Mixed grains, threshed	[2]	[3] 2, 045	2, 530
Oats, threshed or fed unthreshed	27, 516	36, 835	45, 700
Barley, threshed	11, 615	19, 077	6, 696
Wheat (spring), threshed	12, 461	9, 349	1, 941
Wheat (winter), threshed	5, 901	4, 017	1, 379
Rye, threshed	6, 104	2, 005	1, 265
Flax, threshed	3, 633	7, 357	7, 525
Potatoes	791	732	[4] 154
Sugar beets, for sugar	827	934	709
Sweet corn	[5] 891	[5] 1, 025	[6] 1, 993
Peas, green	[5] 554	[5] 532	[6] 1, 837
Soybeans			[7] 16, 251
Grown alone	[8] 15	[8] 230	[2]
Grown with other crops	42	1, 350	[2]

[1] Soybeans only.
[2] Not reported.
[3] Other than flax and wheat mixture.
[4] Not including farms that harvested less than 15 bushels.
[5] For sale.
[6] For sale and home use.
[7] For all purposes.
[8] For all purposes except green manure.

In 1950, 794 of the 1,535 farms were operated by full owners, 290 by part owners, 5 by managers, and 446 by tenants. Of the tenant farms, 209 were operated by cash tenants; 125 by share-cash tenants; 78 by share tenants and croppers; and 34 by persons whose terms of tenancy were not specified.

Soil Survey Methods and Definitions

The scientist who makes a soil survey examines soils in the field, classifies the soils in accordance with facts that he observes, and maps their boundaries on an aerial photograph or other map.

Field study

The soil surveyor bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern, but are located according to the lay of the land. Usually they are not more than a quarter of a mile apart and sometimes they are much closer. In most soils the borings or holes reveal several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn the things about this soil that influence its capacity to support plant growth. Some properties noted during examination are the following.

Color is usually related to the amount of organic matter. The darker the surface soil, as a rule, the more organic matter it contains. Streaks and spots of gray, yellow, and brown in the lower layers generally indicate poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers, and is later checked by laboratory analysis. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate.

Structure, which is the way the individual soil particles are arranged in larger grains and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation.

Other characteristics observed in the course of the field study and considered in classifying the soil include the following: The depth of the soil over bedrock or compact layers; the presence of gravel or stones in amounts that will interfere with cultivation; the steepness and pattern of slopes; the degree of erosion; the nature of the underlying parent material from which the soil has developed; and acidity or alkalinity of the soil as measured by chemical tests.

Classification

On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified into phases, types, and series. The soil type is the basic classification unit. A soil type may consist of several phases. Types that resemble each other in most of their characteristics are grouped into soil series.

As an example of soil classification, consider the Wadena series of Nicollet County. This series is made up of two soil types, subdivided into phases, as follows:

Series	*Type*	*Phase*
Wadena	Sandy loam	Nearly level.
		Undulating.
		Eroded gently rolling.
	Loam	Nearly level.
		Undulating.

Areas that have little true soil are not classified into types and series, but are identified by descriptive names. Examples in Nicollet County are Rough broken land, clayey till, and Mixed alluvium.

If two or more soils are so intricately associated in small areas that it is not feasible to show them separately on the soil map, they are mapped together and called a soil complex. Several complexes are mapped in Nicollet County; examples are the Clarion-Lakeville loams, and the Storden-Lakeville loams.

Soils

Nicollet County is in the region of prairie soils identified on a generalized soil map of Minnesota as the Clarion-Nicollet-Webster soil association.[2]

[2] McMiller, P. R. soils of minnesota. Minn. Agr. Expt. Sta. Ext. Bul. 278, 8 pp, illus., 1954.

Most of the soils in the county have formed under prairie vegetation, but there is evidence that forest gradually encroached on parts of the prairie at some time in the distant past.

Soils that have developed under permanent forest generally have light-colored surface layers and compact clayey subsoils. Where trees encroached on a prairie, the surface soils and subsoils have some of the characteristics of soils that developed under permanent forest. Scattered areas of such soils occur in Nicollet County, chiefly near the larger streams and their tributaries. These soils have the dark-colored surface layer characteristic of the prairie soils, but immediately below this the material is grayer and somewhat coarser. Beneath the gray layer, the subsoil is finer textured, blocky, and rather compact. The deeper subsoil is similar to that of prairie soils.

Soils that have developed under prairie vegetation have accumulations of organic matter in the upper layers, the quantity depending on the activity of the other soil-forming forces. On the nearly level areas, where the soils are wet much of the time, grasses grow luxuriantly, and as a result a large amount of organic matter accumulates in the soils. On more rolling areas, much of the rainwater runs off and accumulates in depressions or flows into drainageways and streams. Thus less water percolates through the soils, which consequently dry out more rapidly and support less plant growth. For this reason, the soils of the undulating or rolling areas have less organic matter and are lighter colored than the soils that are nearly level.

General soil areas

Figure 2 shows the general outline of the important soil areas in the county. These are described in the following paragraphs.

Dorchester-Hubbard.—These are the nearly level soils of the Minnesota River Valley. They consist largely of the medium-textured, first-bottom Dorchester soils and the Hubbard soils of the sandy terraces. The first-bottom soils are highly fertile soils but their usefulness is somewhat limited by overflow from the river. The terrace soils are usually droughty, and lack of moisture limits their productivity.

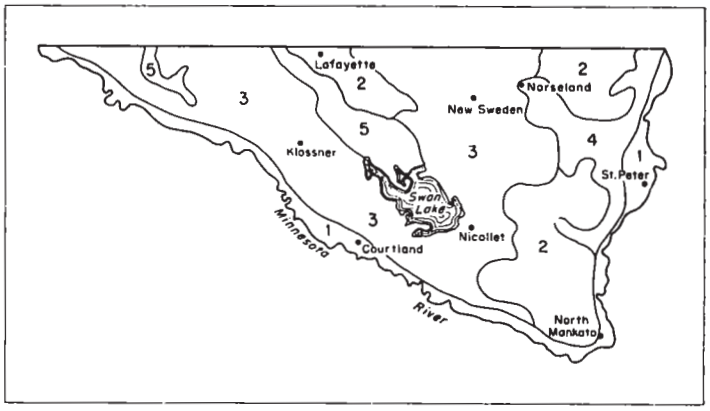

Figure 2.—General soil areas of Nicollet County, Minnesota.

1. Dorchester-Hubbard
2. Webster-Nicollet
3. Nicollet-Webster-Clarion
4. Le Sueur-Clarion-Nicollet
5. Clarion-Storden-Lakeville

Webster-Nicollet.—These are the large areas of nearly level, poorly drained to moderately well drained upland soils in the county. They have dark-colored, moderately fine textured surface soils developed from a calcareous, medium-textured to moderately fine textured till. Runoff is slow, and large portions of the areas are artificially drained to remove the excess water.

Nicollet-Webster-Clarion.—This area, which consists of nearly level to undulating upland soils, is the major soil area in the county. The Nicollet, Webster, and Clarion soils are the most common. This area differs from the Webster-Nicollet areas in having a little stronger relief and a smaller acreage of poorly drained soils.

Le Sueur-Clarion-Nicollet.—This relatively small area in the northeastern part of the county is much like the preceding group, except that it includes a considerable acreage of prairie border soils. They are soils of the prairie on which timber encroached.

Clarion-Storden-Lakeville.—This group of soils occupies a gently rolling to rolling area northwest of Swan Lake and a smaller area in the northwestern part of the county. The Clarion and Storden soils formed from calcareous till and the Lakeville from calcareous, water-modified glacial drift.

Use and management of soils

Most of the soils of Nicollet County were originally well supplied with organic matter and were in good physical condition. After years of cultivation, however, the organic matter has been depleted in many areas, some of the soils have lost their favorable structure and are in poor physical condition, and in a few instances yields have declined substantially. Several years of good management will be required to restore the productivity of these soils.

Crop rotation.—The foundation of a management system that will maintain or restore productivity is systematic crop rotation. For all the agricultural soils of Nicollet County, the rotation should include a deep-rooted legume to help maintain the permeability of the soil and to restore organic matter. Replenishment of organic matter through use of a suitable crop rotation and the application of barnyard manure will ordinarily maintain the supply of plant nutrients in the soil. In areas where plant nutrients and organic matter are very low, commercial fertilizers may be beneficial.

Fertilization.—Alfalfa and sweetclover can be grown without lime on most of the fine-textured soils of the county. Many of these soils, however, are naturally low in phosphorus, and some, in potassium as well. A complete fertilizer may be required for some crops, such as corn and sugar beets. For legume crops, some soils need phosphorus only, but others need both phosphorus and potassium. Soil tests will show the kind and amount of fertilizer needed for specific crops. Tests should be made not more than 2 years before the fertilizer is applied. The county agricultural agent may be consulted for assistance in taking soils samples. The Soil Testing Laboratory at the University Farm in St. Paul is equipped to make the tests.

Pasture management.—Pastures are generally managed poorly. Many permanent pastures are in need of renovation and reseeding. Legume-grass mixtures are suitable pasture crops. Commercial fertilizers should be used, and lime also, if soil tests show a need for it. Grazing should be regulated. It is advisable to control weeds by mowing and to spread animal droppings by harrowing.

Erosion control.—Erosion is a serious hazard only where the land is rolling or steep. Such land should be kept in sod crops. The hilly land adjacent to the Minnesota River bottoms is best suited to permanent pasture or trees. Some terrace soils are sandy and are easily eroded by wind, particularly in spring and fall when there is no vegetative cover. Only in occasional years is wind erosion severe.

Water control.—Water control includes reduction of runoff to prevent sheet and gully erosion, removal of excess water where natural drainage is inadequate, and flood protection.

Except for the nearly level areas, most of the soils of Nicollet County need some care to prevent excessive runoff. A crop rotation that includes a large proportion of legumes is the chief requirement. Legumes restore organic matter to the soil, and thereby increase water-absorbing capacity. Natural waterways can be stabilized by keeping them permanently in grass; they should be fertilized and the hay removed, so that a good sod will be established. Contour stripcropping also helps to control runoff.

Many parts of Nicollet County, particularly areas of Webster and Glencoe soils, need artificial drainage. If outlets are available, tiling is the most efficient means of providing underdrainage. Several large drainage ditches have been constructed in places where natural outlets were lacking. On some areas of Glencoe soil, drainage is difficult and expensive because the tile has to be set at considerable depth in the adjacent higher land in order to connect with the outlets.

Dikes may be needed in some places along the Minnesota River to protect cities and farms from floods.

Management Groups

To show the relationship among the 56 soil types and phases, particularly their significance to agriculture, the soils of the county are arranged in 13 groups. Texture, color, drainage, and topography form the basis for the groupings. On the soil map, each soil is identified by a symbol, and all the soils of one group are shown in the same color.

All the soils in each group have about the same management requirements, and are suitable for the same crops. Use and management suggestions for the various groups are summarized in table 4 and are discussed in the following pages.

Group 1.—Well-drained, medium-textured soils of the undulating uplands and gentle colluvial slopes

(Cb) Clarion silt loam, undulating phase (3 to 7 percent slopes)
(Cc) Clarion silt loam, eroded undulating phase (3 to 7 percent slopes).
(Td) Terril silt loam, very gently sloping phase (0 to 3 percent slopes).
(Te) Terril silt loam, gently sloping phase (3 to 7 percent slopes).

These soils have developed from calcareous parent material. Their surface soils are dark-colored silt loams and their subsoils yellowish-brown clay loams. The Clarion soils occupy undulating uplands and the Terril

TABLE 4.—*Use and management suggestions for the soils of Nicollet County, Minn.*

Group description and soils	Suitable uses	Suggested rotations [1 2]	Supplemental practices
Group 1 (Well-drained, medium-textured soils of the undulating uplands and gentle colluvial slopes). Clarion silt loam, undulating phase. Clarion silt loam, eroded undulating phase. Terril silt loam, very gently sloping phase. Terril silt loam, gently sloping phase.	Corn, soybeans, small grains, flax, canning crops, alfalfa, clovers, grasses, sugar beets.	3 years: G–H–C. 4 years: G–H–H–C. 6 years: G–H–H–C–G (Sw. Cl.)–C.	Grassed waterways.
Group 2 (Moderately well drained, moderately fine textured soils of the uplands on gentle slopes). Le Sueur silty clay loam, gently undulating phase. Le Sueur silty clay loam, undulating phase. Nicollet silty clay loam, gently undulating phase.	Corn, soybeans, small grains, flax, canning crops, alfalfa, clovers, grasses, sugar beets.	2 years: G(Sw. Cl.)–C. 3 years: G–H–C. 4 years: G–H–C–C. 5 years: G–H–H–C–C. or G–G–H–H–C.	Grassed waterways.
Group 3 (Poorly drained, moderately fine textured soils of the uplands on very gentle slopes). Harpster silty clay loam. Webster silty clay loam, nearly level phase. Webster silty clay loam, colluvial phase.	Corn, soybeans, flax, small grains, canning crops, legumes and grasses, sugar beets.	2 years: G(Sw. Cl.)–C. 3 years: G–H–C. 4 years: G–H–C–C. 5 years: G–H–H–C–C. or G–G–H–H–C.	Tile drainage.
Group 4 (Poorly drained, dark-colored, moderately fine textured soils of the upland depressions). Blue Earth silty clay loam. Glencoe silty clay loam.	Corn, soybeans, clover and grasses, sugar beets.	2 years: G(Sw. Cl.)–C. 3 years: G–H–C. 4 years: G–H–C–C.	Tile drainage.
Group 5 (Well-drained, moderately coarse textured and coarse-textured soils of the terraces on gentle slopes). Hubbard loamy sand, eroded nearly level phase. Hubbard loamy sand, eroded undulating phase. Hubbard sandy loam, nearly level phase. Hubbard sandy loam, eroded undulating phase. Wadena sandy loam, nearly level phase. Wadena sandy loam, undulating phase.	Corn, small grains, sweet clover, canning crops, alfalfa, bromegrass, clover.	2 years: G(Sw. Cl.)–C. 3 years: G–H–H. 4 years: G–G–H–H. or G–H–H–C.	Wind stripcropping.
Group 6 (Well-drained, medium-textured soils of the terraces on gentle slopes). Kasota silt loam, nearly level phase. Kasota silt loam, undulating phase. Wadena loam, nearly level phase. Wadena loam, undulating phase.	Corn, soybeans, small grains, canning crops, alfalfa, bromegrass, clover.	3 years: G–H–H. or G–H–C. 4 years: G–H–H–C. or G–G–H–C. or G–H–G–C. or G–H–C–C.	Grassed waterways.
Group 7 (Excessively drained, moderately coarse textured and coarse-textured soils of the terraces on moderate slopes). Hubbard loamy sand, eroded gently rolling phase. Hubbard sandy loam, eroded gently rolling phase. Wadena sandy loam, eroded gently rolling phase.	Small grains, sweet clover, legumes and grasses.	3 years: G–H–H. 4 years: G–H–H–H.	Grassed waterways and stripcropping.
Group 8 (Well-drained, medium-textured and moderately coarse textured soils of the undulating uplands and gentle colluvial slopes). Clarion-Lakeville loams, eroded undulating phases. Clarion-Dickinson loams, undulating phases. Clarion-Dickinson loams, eroded undulating phases. Terril sandy loam and loam, very gently sloping phases. Terril sandy loam and loam, gently sloping phases.	Small grain, corn, alfalfa, bromegrass, clover.	3 years: G–H–C. 4 years: G–H–H–C. or G–H–H–H.	Grassed waterways and stripcropping.

TABLE 4.—*Use and management suggestions for the soils of Nicollet County, Minn.*—Continued

Group description and soils	Suitable uses	Suggested rotations [1] [2]	Supplemental practices
Group 9 (Well-drained, medium-textured and coarse-textured soils of the uplands on moderate and steep slopes). Clarion silt loam, eroded gently rolling phase. Clarion silt loam, gently rolling phase. Clarion-Dickinson loams, eroded gently rolling phases. Clarion-Storden loams and silt loams, eroded gently rolling phases. Clarion-Storden-Lakeville loams and silt loams, eroded gently rolling phases. Storden-Clarion loams and silt loams, eroded rolling phases. Storden loam and silt loam, hilly phases. Storden-Lakeville loams, eroded rolling phases. Terril sandy loam and loam, sloping phases. Terril silt loam, sloping phase.	Small grains, clover, alfalfa, bromegrass, corn.	4 years: {G–H–H–C. / G–H–H–H. 6 years: G–H–H–C–G (Sw. Cl.)–C. Pasture or hay.	Grassed waterways or stripcropping.
Group 10 (Well-drained and imperfectly drained, medium-textured and moderately fine textured soils overlying bedrock within 36 inches on gentle slopes). Copas loam, nearly level phase. Copas loam, undulating phase. Faxon silty clay loam, deep phase.	Corn, small grains, clover, bromegrass, alfalfa.	2 years: G–(Sw. Cl.)–C. 3 years: G–H–C. 4 years: G–H–H–C.	Wind stripcropping.
Group 11 (Soils of the flood plains) Cass fine sandy loam. Dorchester silty clay loam. Dorchester soils, undifferentiated. Mixed alluvium. Oshawa silty clay loam. Volin silt loam, nearly level phase. Volin silt loam, undulating phase.	Corn, soybeans, sugar beets, canning crops, alfalfa, clover, grasses.	2 years: G(Sw. Cl.)–C. 3 years: G(Sw. Cl.)–C–C. 4 years: {G–H–H–C. / G–H–C–C.	Drainage.
Group 12 (Organic soils) Peat and muck. Peat and muck, shallow phases.	Corn, silage corn, soybeans, small grain, truck crops, clover, grasses.	3 years: G–H–C. 4 years: G–M–G–C. Pasture.	Drainage.
Group 13 (Miscellaneous nonarable land types) Marsh. Rough broken land, clayey till. Rough broken land, sandy and gravelly materials.	Nonagricultural.		

[1] Rotations suggested are those suited to the livestock farming systems common to Nicollet County.
[2] Letters in Suggested rotations column stand for the following:
G – Any small grain, such as oats or barley. Flax may be substituted for small grain on soils where it is adapted.
H – Legume or legume-grass hay, or rotation pasture.
C – Corn, or other adapted intertilled crops such as soybeans, sugar beets, or sweet corn.
G(Sw. Cl.) – Small grain seeded with sweetclover, for use as a green manure.

soils occur in areas between the bottom lands or sandy terraces and the uplands. The soils of group 1 are readily permeable to water and plant roots. They are very productive and are well adapted to all crops grown in the county. Grassed waterways are advisable to control erosion. Suitable crops and suggested rotations are given in table 4.

Oats or barley may be used for the grain crop. Soybeans, sugar beets, or any other intertilled crop may be substituted for corn. The hay crop may be alfalfa alone, or alfalfa mixed with bromegrass or timothy. Flax is a good companion crop for alfalfa, and may be substituted for the grain crop. Canning peas also may be planted in place of the small grain. After the peas are harvested, alfalfa can be seeded without a companion crop, or an early variety of soybeans can be planted.

Group 2.—Moderately well drained, moderately fine textured soils of the uplands on gentle slopes

(La) Le Sueur silty clay loam, gently undulating phase (0 to 3 percent slopes).
(Lb) Le Sueur silty clay loam, undulating phase (3 to 7 percent slopes).
(Na) Nicollet silty clay loam, gently undulating phase (0 to 3 percent slopes).

These soils have developed on calcareous glacial material. Slopes are more gentle, as a rule, than those of the soils in group 1. Nevertheless, water runs off and the soils dry out in time for spring planting. In some of the lower lying areas, artificial drainage is beneficial.

The Nicollet soil has developed under a grass cover, but the Le Sueur soils formed under a grass cover upon which

the forest encroached. As a result of this difference in vegetation, lime has been leached to a greater depth in the Le Sueur soils than in the Nicollet, and the Le Sueur subsoil is more compact. These soils are very productive and are suitable for many kinds of crops. They present no serious management problems, but grassed waterways for erosion control are advisable. Table 4 gives the suitable crops and suggested rotations for this group of soils.

Oats or barley may be used for the grain crop. Soybeans, sugar beets, or any other intertilled crop may be substituted for corn. The hay crop may be alfalfa alone, or alfalfa mixed with bromegrass or timothy. Flax or canning peas may be planted instead of small grain. After peas are harvested, alfalfa or an early spring variety of soybeans can be planted. Under good management, which includes returning all crop residues to the soil, corn can be grown for 2 successive years.

Group 3.—Poorly drained, moderately fine textured soils of the uplands on very gentle slopes

(Ha) Harpster silty clay loam (0 to 3 percent slopes).
(Wf) Webster silty clay loam, nearly level phase (0 to 3 percent slopes).
(Wg) Webster silty clay loam, colluvial phase (0 to 3 percent slopes).

These soils have developed from a moderately fine textured calcareous glacial till. The soils are so nearly level that there is little or no surface runoff. Consequently, unless artificially drained, they warm up so slowly in spring that planting is delayed. The soils are well supplied with organic matter and are neutral to alkaline in reaction. Suitable crops and suggested rotations are given in table 4.

The Harpster soil often benefits from applications of phosphorus and potassium fertilizers. All of the soils need artificial drainage. When they are drained, they are highly productive. If the soils are well managed, corn can be grown for two successive years.

Group 4.—Poorly drained, dark-colored, moderately fine textured soils of the upland depressions

(Ba) Blue Earth silty clay loam (0 to 3 percent slopes).
(Ga) Glencoe silty clay loam (0 to 3 percent slopes).

These poorly drained soils have developed from calcareous moderately fine textured glacial till. They are depressional and unless artificially drained are not suited to general farm crops. If adequately drained by tiling, they are productive. Table 4 gives the suitable crops and suggested rotations for these soils.

Alfalfa is not suitable for these soils, because they are so wet that winter killing is a hazard.

Group 5.—Well-drained, moderately coarse textured and coarse-textured soils of the terraces on gentle slopes

(Hb) Hubbard loamy sand, eroded nearly level phase (0 to 3 percent slopes).
(Hc) Hubbard loamy sand, eroded undulating phase (3 to 7 percent slopes).
(He) Hubbard sandy loam, nearly level phase (0 to 3 percent slopes).
(Hf) Hubbard sandy loam, eroded undulating phase (3 to 7 percent slopes).
(We) Wadena sandy loam, nearly level phase (0 to 3 percent slopes).
(Wd) Wadena sandy loam, undulating phase (3 to 7 percent slopes).

These soils have loamy sand and sandy loam surfaces overlying sand or gravel subsoils. The Hubbard soils are more uniform in texture of the subsoil and substratum than the Wadena soils, and are more deeply leached. The Wadena soils have a finer textured upper subsoil than the Hubbard, and are underlain by calcareous sand and gravel at depths ranging from 24 to 36 inches. The Wadena soils are more productive than the Hubbard soils, because they have a better water-retaining capacity.

All soils of this group are extensively farmed, but unless rainfall is ample and well distributed during the summer, crops are likely to be damaged by drought. Stripcropping should be practiced as protection against wind erosion, which is more serious a hazard than water erosion. The sandy soils tend to drift, particularly when the ground is not covered with vegetation, as early in spring before planting and in fall after the crops have been harvested. Suitable crops and suggested rotations are given in table 4.

Canning crops, particularly green peas, are a suitable substitute for small grain. The soils are not well suited to alfalfa. If this crop is grown, the soils should be tested for acidity, and lime, if needed, should be applied well in advance of seeding.

Group 6.—Well-drained, medium-textured soils of the terraces on gentle slopes

(Ka) Kasota silt loam, nearly level phase (0 to 3 percent slopes).
(Kb) Kasota silt loam, undulating phase (3 to 7 percent slopes).
(Wa) Wadena loam, nearly level phase (0 to 3 percent slopes).
(Wb) Wadena loam, undulating phase (3 to 7 percent slopes).

These soils developed from medium-textured outwash overlying calcareous sand or gravel at 36 to 44 inches. They are less droughty than the soils of group 5 and less subject to wind erosion. The Kasota soils are finer textured than the Wadena and are the most productive of the terrace soils because of their greater water-holding capacity. Table 4 gives the suitable crops and suggested rotations for this group.

These soils are well suited to canning crops. In the suggested rotations, early canning peas may be substituted for small grains, and sweet corn for field corn. Before alfalfa or sweetclover is planted, the soils should be tested for lime requirements. Waterways should be grassed to control erosion.

Group 7.—Excessively drained, moderately coarse textured and coarse-textured soils of the terraces on moderate slopes

(Hd) Hubbard loamy sand, eroded gently rolling phase (7 to 13 percent slopes).
(Hg) Hubbard sandy loam, eroded gently rolling phase (7 to 13 percent slopes).
(We) Wadena sandy loam, eroded gently rolling phase (7 to 13 percent slopes).

The soils have developed from sandy outwash that overlies sand and gravel. Because of their moderate slopes and coarse subsoils they are droughty and erodible.

The suitable crops and suggested rotations for these soils are given in table 4. The soils of this group are not suitable for intertilled crops. They have already lost considerable surface soil through erosion, and require

contour stripcropping, grassed waterways, or similar protective measures to prevent further losses. Most of the time, they should be used for hay and pasture crops. Small grains can be grown for the purpose of establishing new stands of legumes.

Group 8.—Well-drained, medium-textured and moderately coarse textured soils of the undulating uplands and gentle colluvial slopes

(Ck) Clarion-Lakeville loams, eroded undulating phases (3 to 7 percent slopes).
(Cf) Clarion-Dickinson loams, undulating phases (3 to 7 percent slopes).
(Cg) Clarion-Dickinson loams, eroded undulating phases (3 to 7 percent slopes).
(Ta) Terril sandy loam and loam, very gently sloping phases (0 to 3 percent slopes).
(Tb) Terril sandy loam and loam, gently sloping phases (3 to 7 percent slopes).

The Clarion soils have developed from calcareous loam glacial till, the Lakeville from medium-textured material overlying calcareous sand and gravel, the Dickinson from loose sandy noncalcareous drift, and the Terril from medium-textured colluvium.

Grassed waterways and stripcropping are needed to control erosion. Table 4 gives the suitable crops and suggested rotations for these soils.

Oats or barley may be used for the grain crop. Soybeans, sugar beets, or some other intertilled crop can be substituted for corn. The hay crop may be alfalfa alone, or alfalfa mixed with either timothy or bromegrass. Flax is a good companion crop for alfalfa, and it may be substituted for the grain crop that precedes the hay crop in the rotation. Canning peas may be used in place of small grains, and sweet corn in place of field corn. After the early canning peas are harvested, alfalfa or an early maturing variety of soybeans may be planted.

Group 9.—Well-drained, medium-textured and coarse-textured soils of the uplands on moderate and steep slopes

(Ce) Clarion silt loam, eroded gently rolling phase (7 to 13 percent slopes).
(Cd) Clarion silt loam, gently rolling phase (7 to 13 percent slopes)
(Ch) Clarion-Dickinson loams, eroded gently rolling phases (7 to 13 percent slopes).
(Cl) Clarion-Storden loams and silt loams, eroded gently rolling phases (7 to 13 percent slopes).
(Cm) Clarion-Storden-Lakeville loams and silt loams, eroded gently rolling phases (7 to 13 percent slopes).
(Sb) Storden-Clarion loams and silt loams, eroded rolling phases (13 to 20 percent slopes).
(Sa) Storden loam and silt loam, hilly phases (20 percent + slopes).
(Sc) Storden-Lakeville loams, eroded rolling phases (13 to 20 percent slopes).
(Tc) Terril sandy loam and loam, sloping phases (7 to 13 percent slopes).
(Tf) Terril silt loam, sloping phase (7 to 13 percent slopes).

The soils of this group[2a] have developed from the same parent materials as those in group 8. The major difference between the groups is that group 9 soils have stronger slopes. The soils of the steeper slopes in this group are not important agriculturally.

[2a] Legend for soil map shows a soil that does not appear in this county (Sd), Storden-Lakeville loams, hilly phases.

These steep soils are best suited to hay or pasture. Grassed waterways and stripcropping are needed.

Group 10.—Well-drained and imperfectly drained, medium-textured and moderately fine textured soils overlying bedrock within 36 inches on gentle slopes

(Cn) Copas loam, nearly level phase (0 to 3 percent slopes).
(Co) Copas loam, undulating phase (3 to 7 percent slopes).
(Fa) Faxon silty clay loam, deep phase (0 to 3 percent slopes)

These soils developed from a thin mantle of outwash material overlying sandstone bedrock. Because of their shallowness to bedrock, the Copas soils tend to be droughty. Where the depth to bedrock is less than 2 feet, yields of farm crops, particularly alfalfa, are likely to be low because of insufficient moisture. The Faxon soil is wet because of seepage from the adjacent uplands. Most of the Faxon soil is more suitable for permanent pasture than for other crops. The suitable crops and suggested rotations are given in table 4.

Early canning peas may be substituted for small grain in the rotation, and sweet corn for field corn. Before alfalfa is planted, the soil should be tested for lime requirements. Stripcropping should be practiced to protect against wind erosion.

Group 11.—Soils of the Flood Plains

(Ca) Cass fine sandy loam (0 to 3 percent slopes).
(Da) Dorchester silty clay loam (0 to 3 percent slopes).
(Db) Dorchester soils, undifferentiated (0 to 3 percent slopes).
(Mb) Mixed alluvium.
(Oa) Oshawa silty clay loam (0 to 3 percent slopes).
(Va) Volin silt loam, nearly level phase (0 to 3 percent slopes).
(Vb) Volin silt loam, undulating phase (3 to 7 percent slopes).

These soils have developed from alluvial material adjacent to the Minnesota River. The Cass and Volin soils occupy a high-bottom position and are flooded only during exceptionally high water, while the first-bottom Dorchester soils are flooded frequently. Table 4 lists the suitable crops and suggested rotations for these soils. Yields of grasses and legumes are good if the crops are not damaged by flooding.

Group 12.—Organic soils

(Pa) Peat and muck.
(Pb) Peat and muck, shallow phases.

These soils consist of plant remains in various states of decomposition. The soils have formed under very poorly drained or ponded conditions. If drained and fertilized, these soils are productive. They are especially well adapted to tame grasses. Reed canarygrass often does well, even without drainage. Table 4 gives the suitable crops and suggested rotations for these soils. Flooding and frost are serious crop hazards.

Group 13.—Miscellaneous nonarable land types

(Ma) Marsh.
(Ra) Rough broken land, clayey till.
(Rb) Rough broken land, sandy and gravelly materials.

The marsh areas are water saturated. If the soil material is peat, drained areas could be managed in the same way as soils of group 12. Marsh areas that contain fine-textured mineral soils can be managed like the soils of group 4. Some areas of rough broken land are pastured, but most are wooded.

Expectable crop yields

Table 5 gives estimated average acre yields of the principal crops grown in Nicollet County, over a period of years, under management practices suggested in the section, Use and Management of Soils. The estimates are based primarily on interviews with farmers, with members of the staff of the Minnesota Agricultural Experiment Station, and with others familiar with the agriculture of the county. It was assumed that rotations similar to those suggested in this report were adopted, that appropriate supplemental practices were followed, that lime and fertilizer were used according to recommendations based on soil tests, and that farm manure was applied before the crop of highest value in the rotation. The figures given in table 5 are estimated averages for all areas of the given soil. Yields will be higher in some years and lower in others, depending on weather conditions and the level of management.

TABLE 5.—*Estimated average acre yields of principal crops grown in Nicollet County, Minn., under management practices suggested in this report*

[Blank spaces indicate crop is not commonly grown because it is not adapted to the soil]

Soil	Corn	Corn silage	Soybeans	Oats	Barley	Flax	Hay (Alfalfa or alfalfa-bromegrass)	Hay (Red clover, timothy, bromegrass)	Rotation pasture
	Bu.	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Cow-acre-days* [1]
Blue Earth silty clay loam	50	10	18	40	25	12		1. 75	150
Cass fine sandy loam	55	11	20	45	30	10	2. 50	1. 75	135
Clarion silt loam:									
Undulating phase	60	12	22	55	38	13	3. 50	2. 00	175
Eroded undulating phase	53	10	20	50	35	12	3. 25	2. 00	167
Gently rolling phase	53	10	17	50	35	10	3. 00	1. 75	150
Eroded gently rolling phase	47	8	14	40	26	10	2. 75	1. 50	135
Clarion-Dickinson loams:									
Undulating phases	38	6	10	35	18	8	2. 50	1. 50	125
Eroded gently rolling phases	35	5	8	30	15	7	2. 00	1. 25	100
Eroded undulating phases	35	5	8	30	15	7	2. 00	1. 25	100
Clarion-Lakeville loams, eroded undulating phases	35	5	8	30	15	7	2. 00	1. 25	100
Clarion-Storden loams and silt loams, eroded gently rolling phases	45	8	15	40	25	8	2. 75	1. 50	135
Clarion-Storden-Lakeville loams and silt loams, eroded gently rolling phases	30	5	6	30	18	6	2. 00	1. 25	100
Copas loam:									
Nearly level phase	32	6	10	35	20	9	1. 50	1. 25	80
Undulating phase	28	6	10	30	18	9	1. 50	1. 25	80
Dorchester silty clay loam	62	13	22	48	30	15	2. 75	2. 00	165
Dorchester soils, undifferentiated	62	13	22	45	28	15	2. 75	2. 00	175
Faxon silty clay loam, deep phase									
Glencoe silty clay loam	50	13	22	45	30	15		2. 00	175
Harpster silty clay loam	55	10	18	40	25	12	2. 50	1. 75	150
Hubbard sandy loam:									
Nearly level phase	35	6	10	35	18	8	2. 00	1. 25	100
Eroded undulating phase	25	5	8	25	14	7	1. 75	1. 25	90
Eroded gently rolling phase	20	3	6	20	12		1. 25	1. 00	65
Hubbard loamy sand:									
Eroded nearly level phase	20	3	6	20	12		1. 25	1. 00	65
Eroded undulating phase	17	2	5	18	10		1. 00	. 75	50
Eroded gently rolling phase	15	2	5	15	8		1. 00	. 75	50
Kasota silt loam:									
Nearly level phase	55	10	20	50	35	12	2. 75	2. 00	137
Undulating phase	50	9	20	48	32	11	2. 50	1. 75	125
Le Sueur silty clay loam:									
Gently undulating phase	65	12	23	55	38	18	3. 50	2. 00	170
Undulating phase	65	12	22	55	38	15	3. 50	2. 00	170
Marsh									
Mixed Alluvium									
Nicollet silty clay loam, gently undulating phase	65	12	24	58	38		3. 50	2. 00	175
Oshawa silty clay loam									
Peat and muck	40	13	18	35	20	11		2. 00	160
Shallow phases	45	13	18	35	22	13		2. 00	165
Rough broken land:									
Clayey till									
Sandy and gravelly materials									

[1] Cow-acre-days is the number of days per year that 1 acre will support one animal without injury to the pasture.

TABLE 5.—*Estimated average acre yields of principal crops grown in Nicollet County, Minn., under management practices suggested in this report*—Continued

Soil	Corn	Corn silage	Soybeans	Oats	Barley	Flax	Hay (Alfalfa or alfalfa-bromegrass)	Hay (Red clover, timothy, bromegrass)	Rotation pasture
	Bu.	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Cow-acre-days*
Storden-Clarion loams and silt loams, eroded rolling phases	40	7	12	35	22		2. 50	1. 25	120
Storden-Lakeville loams, eroded rolling phases				30	20		2. 00	1. 00	100
Storden loam and silt loam, hilly phases				30	20		2. 00	1. 25	100
Terril sandy loam and loam:									
Very gently sloping phases	60	11	23	55	38	12	3. 50	2. 00	170
Gently sloping phases	55	10	20	50	35	10	3. 25	2. 00	165
Sloping phases	45	9	18	45	32	10	2. 75	1. 75	150
Terril silt loam:									
Very gently sloping phase	65	12	24	58	38	14	3. 50	2. 00	175
Gently sloping phase	60	12	23	55	38	13	3. 50	2. 00	170
Sloping phase	50	10	20	50	35	11	3. 00	2. 00	155
Volin silt loam:									
Nearly level phase	65	12	24	58	38	18	3. 50	2. 00	175
Undulating phase	60	12	23	55	38	15	3. 50	2. 00	170
Wadena sandy loam:									
Nearly level phase	35	6	10	35	18	8	2. 00	1. 25	100
Undulating phase	25	5	8	25	14	7	1. 75	1. 25	90
Eroded gently rolling phase	20	3	6	20	12	7	1. 25	1. 00	65
Wadena loam:									
Nearly level phase	40	7	14	40	23	10	1. 75	1. 25	90
Undulating phase	30	4	9	35	17	9	1. 50	1. 00	75
Webster silty clay loam:									
Nearly level phase	65	13	24	50	35	18	3. 00	2. 00	165
Colluvial phase	65	12	24	55	38	17	3. 50	2. 00	175

Capability groups of soils

Capability classes are practical groupings based on the relative suitability of soils for tilled crops, forage, forestry, wildlife, or recreation and on the risks of erosion or other damage. Eight broad groups of soils are provided in the capability system. Each soil is placed in one of these broad groups by joint concurrence of several persons who have knowledge of the soils and agriculture of the area.

Soils that are nearly level, well drained, free from overflow, at least fairly fertile, and not otherwise limited are placed in class I. They are widely adaptable and the user of them has many choices open to him. He can use his class I soils for crops without special practices, and can choose one of several cropping systems; or if he wishes he may use the soil for pasture or for some other purpose.

Soils are placed in class II if they are a little less widely adaptable and thus more limited than those in class I. A gently sloping soil, for example, must be farmed on the contour, kept under vegetation most of the time, or handled in some other manner in order to control erosion. Other soils are in class II because they are too droughty or too wet or are limited by depth.

Class III soils have more narrow adaptations for use or more stringent management requirements than class II soils, but can be used for regular cropping. Other soils that are more limited and have narrower crop adaptations than those of class III, but are still usable for tillage part of the time or with special precautions, are placed in class IV.

Soils not suitable for cultivation, or on which cultivation is not advisable, are in classes V, VI, VII, or VIII. Class V includes soils not subject to erosion but unsuitable for cultivation because of standing water or frequent overflows. Class VI contains the soils that are steep or droughty or have other serious limitations, but will produce fairly good amounts of forage or forest products. As a rule, class VI soils should not be cultivated, but some of them can safely be disturbed enough to prepare them for orchards, tree crops, or extremely long-producing pastures. Soils in class VII are more limited than those in class VI and usually give only fair or poor yields of forage or wood products. Soils in class VIII are so severely limited that they produce little useful vegetation. They may make attractive scenery, or may be parts of useful watersheds. Some have value for wildlife. No class VIII soils were mapped in Nicollet County.

Subclasses.—Since the broad capability classes are based on total suitability of the soils for different uses, one class usually contains different kinds of soils. The kinds of management problems then differ because the soils are different. Class II soils in this county, for example, consist of undulating and gently sloping soils subject to erosion, nearly level soils that need supplementary drainage or protection from overflow, and others that have enough sand and gravel in the profile to be slightly droughty. It is convenient to recognize, within the broad classes, capability subclasses based on the dominant kind of limitation. As many as four subclasses may be recognized, according to these dominant limitations or risks: Risk of erosion (e), excess water (w), shallow or droughty soils (s), or unusually hazardous climate (c). The subclass is denoted by a small letter following the class number, such as IIe, IIw, IIs, or IIc.

Capability classes and subclasses in Nicollet County.—Following are definitions of the capability classes and subclasses of the soils mapped in Nicollet County.

CLASS I.—Soils safe for use under intensive cultivation without special practices to control runoff or erosion, and which may be expected to produce high yields under good soil and crop management. Class I is not subdivided.

CLASS II.—Soils that can be used for tilled crops but under slight risks of erosion or other slight limitations.

- IIe: Very gently sloping, undulating, and gently sloping soils, subject to slight erosion.
- IIw: Soils limited by slow drainage.
- IIs: Soils developed in gravelly outwash, and having only moderate moisture supplying capacity.

CLASS III.—Soils that can be used for drilled crops, but under moderate risks of erosion, or other important limitations.

- IIIe: Undulating and gently rolling soils, having good to medium drainage and subject to moderate erosion.
- IIIw: Depressional upland, bottomland, and organic soils limited by excess water.
- IIIs: Alluvial and outwash soils having low to moderate moisture-supplying capacity.

CLASS IV.—Soils that have severe limitations of erosion or droughtiness, or other limitations, and which can be cultivated only with extreme care.

- IVe: Eroded gently rolling upland soils.
- IVs: Sandy or gravelly outwash soils having low to very low moisture-supplying capacity.

CLASS V.—Nearly level soils that are best suited to permanent vegetation because of wetness or other limitations of like degree.

- Vw: Outwash soils kept wet by seepage from adjacent upland.

CLASS VI.—Soils that, because of wetness or other limitations, are unsuited to cultivation, except infrequently to prepare for reseeding long-growing pastures or planting trees.

- VIw: Sandy to clayey soils subject to frequent overflow.
- VIe: Eroded rolling and hilly soils.

CLASS VII.—Soils unsuited to cropping because of erosion, steepness, droughtiness, or other limitation.

- VIIe: Hilly soils, and rough broken land containing clayey till.
- VIIs: Sandy, droughty soils, and rough broken land consisting of sandy and gravelly materials.

The capability class and subclass for each soil in the county are given in the following list:

	Capability class and subclass
Blue Earth silty clay loam (BA)	IIIw.
Cass fine sandy loam (CA)	IIIs.
Clarion silt loam:	
Undulating phase (CB)	IIe.
Eroded undulating phase (CC)	IIIe.
Gently rolling phase (CD)	IIIe.
Eroded gently rolling phase (CE)	IVe.
Clarion-Dickinson loams:	
Undulating phases (CF)	IIe.
Eroded undulating phases (CG)	IIIe.
Eroded gently rolling phases (CH)	IIIe.
Clarion-Lakeville loams, eroded undulating phases (CK)	IIIe.
Clarion-Storden loams and silt loams, eroded gently rolling phases (CL)	IIIe.
Clarion-Storden-Lakeville loams and silt loams, eroded gently rolling phases (CM)	IVe.
Copas loam:	
Nearly level phase (CN)	IIIs.
Undulating phase (CO)	IIIs.
Dorchester silty clay loam (DA)	IIw.
Dorchester soils, undifferentiated (DB)	IIw.
Faxon silty clay loam, deep phase (FA)	Vw.
Glencoe silty clay loam (GA)	IIIw.
Harpster silty clay loam (HA)	IIw.
Hubbard sandy loam:	
Nearly level phase (HE)	IIIs.
Eroded undulating phase (HF)	IIIs.
Eroded gently rolling phase (HG)	IVs.
Hubbard loamy sand:	
Eroded nearly level phase (HB)	IVs.
Eroded undulating phase (HC)	IVs.
Eroded gently rolling phase (HD)	VIIs.
Kasota silt loam:	
Nearly level phase (KA)	I.
Undulating phase (KB)	IIe.
Le Sueur silty clay loam:	
Gently undulating phase (LA)	I.
Undulating phase (LB)	IIe.
Marsh (MA)	Not classified.
Mixed alluvium (MB)	VIw.
Nicollet silty clay loam, gently undulating phase (NA)	I.
Oshawa silty clay loam (OA)	IIIw.
Peat and muck (PA)	IIIw.
Shallow phases (PB)	IIIw.
Rough broken land:	
Clayey till (RA)	VIIe.
Sandy and gravelly materials (RB)	VIIs.
Storden loam and silt loam, hilly phases (SA)	VIIe.
Storden-Clarion loams and silt loams, eroded rolling phases (SB)	VIe.
Storden-Lakeville loams, eroded rolling phases (SC)	VIe.
Terril sandy loam and loam:	
Very gently sloping phases (TA)	IIe.
Gently sloping phases (TB)	IIe.
Sloping phases (TC)	IIIe.
Terril silt loam:	
Very gently sloping phase (TD)	I.
Gently sloping phase (TE)	IIe.
Sloping phase (TF)	IIIe.
Volin silt loam:	
Nearly level phase (VA)	I.
Undulating phase (VB)	IIe.
Wadena loam:	
Nearly level phase (WA)	IIs.
Undulating phase (WB)	IIs.
Wadena sandy loam:	
Nearly level phase (WC)	IVs.
Undulating phase (WD)	IIIs.
Eroded gently rolling phase (WE)	IIIs.

	Capability class and subclass
Webster silty clay loam:	
Nearly level phase (WF)	IIw.
Colluvial phase (WG)	IIw.

Soil types and phases, and miscellaneous land types

In the following pages, the soils of Nicollet County are described. The distribution of the soils is shown on the soil map, and their acreage and proportionate extent are given in table 6.

Soil management is discussed in another section of the report, Use and Management of Soils. In that section the soils of the county are divided into groups, each group consisting of soils that are similar in use suitability and management requirements. On the soil map, these groups are distinguished by color.

Following the soil name at the beginning of each soil description is the letter symbol that identifies the soil on the soil map, and then the number of the group in which the soil has been placed in the management section of the report. For example, (BA, 4) identifies Blue Earth silty clay loam, which is in group 4.

TABLE 6.—*Approximate acreage and proportionate extent of the soils mapped in Nicollet County, Minn.*

Map symbol	Soil	Area	Extent
		Acres	*Percent*
BA	Blue Earth silty clay loam	730	0. 2
CA	Cass fine sandy loam	180	. 1
	Clarion silt loam:		
CB	Undulating phase	23, 520	. 0
CC	Eroded undulating phase	12, 240	4. 2
CD	Gently rolling phase	720	. 2
CE	Eroded gently rolling phase	8, 740	3. 0
	Clarion-Dickinson loams:		
CF	Undulating phases	110	(1)
CG	Eroded undulating phases	140	. 1
CH	Eroded gently rolling phases	160	. 1
CK	Clarion-Lakeville loams, eroded undulating phases	1, 200	. 4
CL	Clarion-Storden loams and silt loams, eroded gently rolling phases	2, 330	. 8
CM	Clarion-Storden-Lakeville loams and silt loams, eroded gently rolling phases	1, 730	. 6
	Copas loam:		
CN	Nearly level phase	1, 400	. 5
CO	Undulating phase	280	. 1
DA	Dorchester silty clay loam	3, 250	1. 1
DB	Dorchester soils, undifferentiated	2, 670	. 9
FA	Faxon silty clay loam, deep phase	790	. 3
GA	Glencoe silty clay loam	28, 540	9. 7
HA	Harpster silty clay loam	26, 530	9. 0
	Hubbard sandy loam:		
HE	Nearly level phase	1, 820	. 6
HF	Eroded undulating phase	390	. 1
HG	Eroded gently rolling phase	160	. 1
	Hubbard loamy sand:		
HB	Eroded nearly level phase	760	. 3
HC	Eroded undulating phase	1, 290	. 4
HD	Eroded gently rolling phase	500	. 2
	Kasota silt loam:		
KA	Nearly level phase	1, 070	. 4
KB	Undulating phase	80	(1)
	Le Sueur silty clay loam:		
LA	Gently undulating phase	9, 230	3. 1
LB	Undulating phase	1, 480	. 5

See footnote at end of table.

TABLE 6.—*Approximate acreage and proportionate extent of the soils mapped in Nicollet County, Minn.*—Con.

Map symbol	Soil	Area	Extent
		Acres	*Percent*
MA	Marsh	6, 220	2. 1
MB	Mixed alluvium	4, 890	1. 7
NA	Nicollet silty clay loam, gently undulating phase	29, 750	10. 1
OA	Oshawa silty clay loam	2, 450	. 8
PA	Peat and muck	5, 360	1. 8
PB	Shallow phases	6, 930	2. 4
	Rough broken land:		
RA	Clayey till	14, 660	5. 0
RB	Sandy and gravelly materials	830	. 3
SB	Storden-Clarion loams and silt loams, eroded rolling phases	2, 020	. 7
SC	Storden-Lakeville loams, eroded rolling phases	400	. 1
SA	Storden loam and silt loam, hilly phases	50	(1)
	Terril sandy loam and loam:		
TA	Very gently sloping phases	100	(1)
TB	Gently sloping phases	960	. 3
TC	Sloping phases	670	. 2
	Terril silt loam:		
TD	Very gently sloping phase	720	. 3
TE	Gently sloping phase	970	. 3
TF	Sloping phase	550	. 2
	Volin silt loam:		
VA	Nearly level phase	150	. 1
VB	Undulating phase	140	. 1
	Wadena sandy loam:		
WC	Nearly level phase	350	(1)
WD	Undulating phase	110	(1)
WE	Eroded gently rolling phase	60	. 1
	Wadena loam:		
WA	Nearly level phase	250	. 1
WB	Undulating phase	260	. 1
	Webster silty clay loam:		
WF	Nearly level phase	60, 490	20. 6
WG	Colluvial phase	6, 800	2. 3
	Water	15, 460	5. 3
	Gravel pits	120	(1)
	Total	293, 760	100. 0

[1] Less than 0.1 percent.

Blue Earth silty clay loam (0 to 3 percent slopes) (BA, 4).—This soil occurs in areas formerly occupied by shallow lakes. Only two or three areas were mapped in the county, the largest one in Granby Township between Swan Lake and Middle Lake.

The surface soil is very dark gray or black silty clay loam, 12 to 18 inches deep. It is high in organic matter and very calcareous. Much of the lime was derived from shells. After it has been cultivated and has become dry, the surface soil is fluffy and ashlike. The subsoil is an olive-gray calcareous clay loam, 5 to 12 inches thick, which is plastic when moist and rather hard when dry. At depths of 20 to 30 inches is a light olive-gray calcareous loamy till containing numerous iron stains and lime concretions.

This soil differs from the related Glencoe silty clay loam in having a higher content of lime throughout. It is poorly drained and is unsuitable for crops unless it is artificially drained. Where lack of outlets makes drainage impossible, this soil can be used only for pasture or wild-hay meadows. In wet years some areas are flooded the year round.

Cass fine sandy loam (0 to 3 percent slopes) (CA, 11).—This soil occurs on the higher flood plains of the Minnesota River. It was developed from sandy sediments deposited by the river during flooding. Typical areas are in Ridgley Township.

The surface soil is very dark grayish-brown fine sandy loam, 12 to 24 inches thick. It is moderately high in organic matter and is normally neutral or weakly alkaline. The subsoil is dark grayish brown or brown sandy loam, 8 to 12 inches thick. This grades to a substratum of brown loamy fine sand or fine sand at depths of 24 to 36 inches.

This soil is more sandy than the related Dorchester soils, has a somewhat darker surface soil, and occurs at slightly higher elevations. It is frequently flooded when the Minnesota River and its tributaries are above flood stage.

Clarion silt loam, undulating phase (3 to 7 percent slopes) (CB, 1).—This is the most extensive and widely distributed well-drained soil in the county. It has developed from calcareous clay loam till under prairie vegetation. It is naturally well drained.

The very dark brown, friable, granular silt loam surface soil, 8 to 12 inches thick, has a high content of organic matter and is slightly to moderately acid. The subsoil, beginning at depths of 10 to 12 inches, is a yellowish-brown moderately plastic clay loam. Below this, at depths ranging from 36 to 40 inches, is a light yellowish-brown, slightly compact, calcareous loam or light clay loam.

This soil is very productive and requires no special treatment other than general good management. It occurs in comparatively small areas and no one farm consists entirely of it; consequently it is generally farmed with the surrounding soils.

Clarion silt loam, eroded undulating phase (3 to 7 percent slopes) (CC, 1).—This soil resembles Clarion silt loam, undulating phase, except that its surface soil is thinner as a result of erosion. The surface soil is yellowish-brown or very dark grayish-brown silt loam that grades toward loam in some places. This soil has somewhat lower productivity than the undulating phase because it has lost part of its topsoil. Satisfactory yields can be obtained by careful soil management.

Clarion silt loam, gently rolling phase (7 to 13 percent slopes) (CD, 9).—This gently rolling phase has essentially the same profile as the undulating phase of Clarion silt loam, but the stronger slope has resulted in a slightly shallower surface layer. In farming this phase, special care is needed to prevent serious erosion.

Clarion silt loam, eroded gently rolling phase (7 to 13 percent slopes) (CE, 9).—This phase has a shallower and somewhat lighter colored surface soil than the gently rolling phase. If it is used for intertilled crops, this soil needs careful management to control erosion.

Clarion-Dickinson loams, undulating phases (3 to 7 percent slopes) (CF, 8).—This soil complex is of minor importance. About 70 percent of it consists of Clarion soils, and about 30 percent of Dickinson soils.

The Dickinson soils, not mapped separately in Nicollet County, have developed from loose sandy material. They have surface soils, 8 to 12 inches thick, of very dark grayish-brown loam that are moderately acid and contain a moderate amount of organic matter. The subsoil, to depths of 24 to 30 inches, is brown loam that grades into yellowish-brown loamy sand or sandy loam. The underlying material is normally acid to depths of 6 to 8 feet.

The Dickinson areas in this complex are subject to wind erosion unless protected by vegetation.

Clarion-Dickinson loams, eroded undulating phases (3 to 7 percent slopes) (CG, 8).—Like Clarion-Dickinson loams, undulating phases, this unit is of minor importance. As a result of water and wind erosion, the surface soils are shallower than those of the undulating phases of Clarion-Dickinson loams. The soils of this unit require careful management to control erosion.

Clarion-Dickinson loams, eroded gently rolling phases (7 to 13 percent slopes) (CH, 9).—This unit differs from Clarion-Dickinson loams, eroded undulating phases, only in slope gradient. Considerable care is needed to control erosion on these soils.

Clarion-Lakeville loams, eroded undulating phases (3 to 7 percent slopes) (CK, 8).—About 60 percent of this complex consists of Clarion loam, and the rest of Lakeville loam. Many areas of the Lakeville soil are on ridgetops, and are likely to be badly eroded.

The Clarion loam of this complex has the same profile characteristics as Clarion silt loam, except for a slightly coarser textured surface soil.

The top layer of Lakeville loam is dark grayish-brown to brown loam or sandy loam, 4 to 8 inches thick. This grades into light yellowish-brown, limy, gravelly sandy loam or loamy sand. The gravelly material extends to depths of as much as 10 to 20 feet, but in some places a limy clay loam lies above it, 3 to 4 feet below the surface. Some gravel has been removed from the ridges to be used for road surfacing, and the shallow pits are now cultivated with the surrounding soils.

In spite of the droughtiness and erodibility of this complex, most of it is used for cultivated crops. Yields are less than are obtained from Clarion silt loam, undulating phase.

Clarion-Storden loams and silt loams, eroded gently rolling phases (7 to 13 percent slopes) (CL, 9).—In some parts of the county, Clarion silt loam, gently rolling phase, is closely intermixed with Storden loam and silt loam. This complex is about 70 percent Clarion soil, and 30 percent Storden soils. The profile of the Clarion soil is much like that described for Clarion silt loam, undulating phase.

The surface soil of Storden loam and silt loam is dark grayish-brown and 4 to 8 inches thick. Below this, after a rather abrupt transition, there is light yellowish-brown calcareous loam to clay loam subsoil. The Storden soils developed on rather sharp slopes where the native prairie grasses grew only sparsely, so no large amount of organic matter accumulated.

Only a small acreage is occupied by this complex. The largest single tract lies northwest of Swan Lake and extends northwestward to the Nicollet-Sibley county line.

Clarion-Storden-Lakeville loams and silt loams, eroded gently rolling phases (7 to 13 percent slopes) (CM, 9).—This complex occurs northwest of Swan Lake in small areas where Clarion, Storden, and Lakeville soils are so intricately mixed they cannot be mapped separately. The terrain in this area is the roughest in the county, except for the bluff lands along the Minnesota River.

Small eroded and gravelly spots are scattered throughout the area. The soils of the complex are among the least productive ones in the county. Skillful management is required if they are used for crops.

Copas loam, nearly level phase (0 to 3 percent slopes) (CN, 10).—This soil developed from outwash on structural benches of sandstone or quartzite. Bedrock is ordinarily within 30 inches of the surface, and a sharp line separates the overlying material from the rock itself. The largest area of this soil is along the Minnesota River in the southern part of Nicollet Township.

The surface soil is an 8- to 12-inch layer of very dark grayish-brown loam, moderately high in organic matter and normally acid. The transition to the reddish-brown loam subsoil is gradual. Hard red sandstone or quartzite underlies the loam subsoil at depths of 20 to 30 inches.

This soil is somewhat droughty because of the shallowness of the loamy soil over the bedrock. It is not very well suited to alfalfa, sweetclover, or other deep-rooted legumes, but other crops do moderately well.

Copas loam, undulating phase (3 to 7 percent slopes) (CO, 10).—This soil differs from Copas loam, nearly level phase, only in slope gradient. It is possibly somewhat more droughty than the nearly level phase because of more rapid surface runoff. The two phases are managed in about the same way.

Dorchester soils, undifferentiated (0 to 3 percent slopes) (DB, 11).—This mapping unit consists of bottom-land soils lying mostly in the wide valley of the Minnesota River. The extremely varied textures of the surface soils and subsoils made it impossible to separate the soils according to texture, so they were mapped as one unit.

The surface soils range from very dark grayish-brown to light grayish-brown calcareous sandy loam, loam, or silt loam. Thin lenses or layers of material of various textures may occur anywhere within the soil profile.

All these soils are used for the crops commonly grown on the uplands. They are often flooded during the spring thaw when the Minnesota River overflows and sometimes after continued heavy summer rains.

Dorchester silty clay loam (0 to 3 percent slopes) (DA, 11).—This soil is associated with the undifferentiated Dorchester soils. It is more nearly level and is not cut by old channels and sandbars as the other bottom-land soils commonly are. Dorchester silty clay loam resembles the other Dorchester soils except that its surface soil and subsoil are finer textured. This soil has a high water-holding capacity and can withstand fairly long periods of dry weather. In favorable seasons, when the land is not flooded, crop yields are among the highest in the county.

Faxon silty clay loam, deep phase (0 to 3 percent slopes) (FA, 10).—This soil is the imperfectly drained to poorly drained associate of the Copas soils. Its drainage is poorer than that of other terrace soils. Many areas are kept continuously wet by water that seeps from the adjacent upland.

The surface soil, 12 to 18 inches deep, is black, granular, mucky, silty clay loam. The surface is generally stony but in some places is nearly stone-free. The subsoil is gray-brown silty clay loam, strongly mottled with olive yellow. This is underlain at depths of 36 to 48 inches by sandstone or quartzite bedrock. This soil is generally used for pasture.

Glencoe silty clay loam (0 to 3 percent slopes) (GA, 4).—This very poorly drained soil occupies depressions within areas of Clarion, Nicollet, and Webster soils. It is widely distributed over the uplands of Nicollet County. Some areas are up to 100 acres in size, but many are too small to be outlined on the map, and like other small depressional areas, are shown by the depression symbol on the map. Many areas are circular; others are narrow tongues projecting into the higher land from the foot slopes, or narrow stringers along intermittent drainageways. In the aggregate, this is an extensive mapping unit.

The surface soil is very dark gray or black granular silty clay loam, 12 to 18 inches thick. In places it is covered by material washed from the surrounding higher land. In these places the surface soil may be as much as 24 inches deep. Other areas are covered by a thin layer of peat or muck. The subsoil, 8 to 12 inches thick, is light brownish-gray silty clay loam, in many places strongly mottled with various shades of yellow. Beneath this is light olive-gray clay loam, highly mottled with yellow and reddish yellow. Normally only the subsoil contains lime, but in places both the surface soil and subsoil may be limy. Unless it is drained, Glencoe silty clay loam is not suitable for crops. When adequately drained this soil is as productive as the Webster soils, but it is more exposed to frost because of its low position.

Harpster silty clay loam (0 to 3 percent slopes) (HA, 3).—Upland flats and slight depressions within Webster soil areas are occupied by this soil. In many places it occurs as the rims of basins or on the flats between basins. It is a "high-lime" soil (locally called an alkali soil) in areas of Webster silty clay loam, nearly level phase.

The surface soil, 6 to 12 inches deep, is black or very dark gray silty clay loam. When the soil is dry the surface is grayish white because of its high content of lime. The upper 6 to 8 inches of the subsoil is dark-gray to grayish-brown clay loam, firm and compact. The subsoil is underlain by a fairly permeable gray silty clay loam, mottled with yellowish brown, that continues to depths of 6 feet or more. The lime content of the soil is detrimental to some crops. Phosphorus and potassium fertilizers are often beneficial to crops grown on this soil.

Some patches of Webster silty clay loam, nearly level phase, are included in the areas mapped as Harpster silty clay loam. These patches were too small to map separately, or to justify mapping as a Harpster-Webster complex. Nevertheless, their presence should be kept in mind when using the soil map.

Hubbard sandy loam, nearly level phase (0 to 3 percent slopes) (HE, 5).—This soil has developed on sandy terraces that are well above overflow. It occurs in two widely separated areas, one in the vicinity of St. Peter, the other near the village of Courtland.

The surface soil is very dark grayish-brown, slightly granular sandy loam, 8 to 12 inches deep. The subsoil, 12 to 18 inches thick, is brown heavy sandy loam or loam; it is underlain by yellowish-brown loamy sand of considerable thickness. Most of this soil is leached of lime to depths of 5 to 6 feet and is medium to strongly acid.

Nearly all this soil is under cultivation. It is not very productive, because the sandy surface soil and subsoil dry out rapidly.

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Hubbard sandy loam, eroded undulating phase (3 to 7 percent slopes) (HF, 5).—The only difference between this phase and the nearly level phase is the slope gradient. The surface soil and subsoil are substantially the same, but this eroded undulating phase has a somewhat shallower surface soil.

Hubbard sandy loam, eroded gently rolling phase (7 to 13 percent slopes) (HG, 7).—This soil occurs along the outer margins of the terraces, near areas of steep, rough, broken land. Except for the difference in slope, this phase has the same surface soil and subsoil characteristics as the eroded undulating phase.

This soil is droughty and crop yields are generally low. Good management, with particular emphasis on erosion control and moisture conservation, is necessary to get satisfactory yields from this soil.

Hubbard loamy sand, eroded nearly level phase (0 to 3 percent slopes) (HB, 5).—This soil occurs in association with Hubbard sandy loam, nearly level phase. It is perhaps the most droughty soil in the county. Crops generally get a good start in the spring when moisture is plentiful, but as the season advances, warmer weather and drying winds deplete the moisture supply, and crops are adversely affected.

The surface soil is dark gray-brown, loose, noncoherent loamy sand, 12 to 18 inches deep. The subsoil, a brown loamy sand, is underlain by a yellowish-brown, noncalcareous, fine to medium sand at depths of 24 to 36 inches.

This soil is subject to moderate wind erosion. Seeds are often blown from the seedbed, or young plants are injured or destroyed by the drifting sand.

Hubbard loamy sand, eroded undulating phase (3 to 7 percent slopes) (HC, 5).—Except for the slope gradient, this soil resembles the eroded nearly level phase. Productivity is low because the soil has low water-holding capacity and is subject to wind erosion.

Hubbard loamy sand, eroded gently rolling phase (7 to 13 percent slopes) (HD, 7).—This phase of Hubbard loamy sand is somewhat less well developed than the nearly level eroded and gently undulating eroded phases. This is an extremely droughty soil; water percolates readily and little is retained. Wind erosion is a hazard unless a vegetative cover is maintained. This soil is not used extensively for farm crops.

Kasota silt loam, nearly level phase (0 to 3 percent slopes) (KA, 6).—This soil occurs in small bodies within areas of Wadena and Hubbard soils, principally in Traverse Township.

The surface soil, 10 to 14 inches deep, is very dark grayish-brown finely granular silt loam. Underlying this is brown compact silty clay loam, 10 to 14 inches thick, that grades into loose calcareous sandy gravelly material at depths ranging up to 44 inches.

Because of its medium-textured surface soil and subsoil, this soil has fair to good water-holding capacity. Crop yields are better than on the related Hubbard and Wadena soils.

Kasota silt loam, undulating phase (3 to 7 percent slopes) (KB, 6).—This soil is similar to Kasota silt loam, nearly level phase, but has stronger slopes and is therefore subject to some erosion. The surface soil is normally somewhat shallower than that of the nearly level phase. Management practices for the two phases are much the same.

Le Sueur silty clay loam, gently undulating phase (0 to 3 percent slopes) (LA, 2).—This moderately well drained soil has developed on calcareous glacial till. It occurs extensively north of Timber Lake. Smaller areas are on the nearly level to gently undulating upland bordering the steep slopes along the Minnesota River.

The surface soil is very dark brown granular silty clay loam, 12 to 14 inches thick. In some places the lower part of it is light gray and has coatings of gray silt particles on the soil aggregates. The subsoil is brown to yellowish-brown slightly blocky heavy silty clay loam. Below this layer is calcareous brownish-yellow clay loam that extends to a considerable depth. Surface drainage is moderately slow, and little soil is lost through erosion. Generally, lime is leached to a depth of 3 feet or more. This soil is highly productive.

Le Sueur silty clay loam, undulating phase (3 to 7 percent slopes) (LB, 2).—This soil occurs only in a few small areas, within the larger areas of Le Sueur silty clay loam, gently undulating phase. The soil characteristics are substantially the same as those of the gently undulating phase, and farming practices on the two phases are similar.

Marsh (MA, 13).—Areas that are covered with water most of the time make up this mapping unit. Water-tolerant grasses, sedges, and small trees and bushes are the common vegetation. If the areas are artificially drained, they can be used for crops. Use and management would be about the same as for the Glencoe soil or for Peat and muck.

Mixed alluvium (MB, 11).—On low ridges or depressions bordering the Minnesota River are deposits of mixed sediments ranging from loamy sands to silty clays. When the river is high, these areas are flooded. Some of this unit is used for farm crops but most of it is in permanent pasture.

Nicollet silty clay loam, gently undulating phase (0 to 3 percent slopes) (NA, 2).—This moderately well drained and moderately fine textured soil has developed under grass from calcareous glacial till. It is distributed throughout the uplands in all parts of the county. It resembles the Le Sueur soils except that the lime is not leached to so great a depth and the subsoil is not so fine textured.

The surface soil consists of very dark gray granular silty clay loam, 12 to 15 inches deep. The subsoil is light olive-brown to dark gray-brown silty clay loam, mottled with pale yellow. This layer grades into light yellowish-brown calcareous clay loam at depths of 30 to 36 inches.

This Nicollet soil is the most productive soil in the county for general farm crops. It does not require artificial drainage and is not subject to erosion.

Oshawa silty clay loam (0 to 3 percent slopes) (OA, 11).—This poorly drained soil occurs on the bottom lands of the Minnesota River and on the foot slopes below Terril soils. The areas on the foot slopes are kept wet by seepage water. Oshawa silty clay loam is associated with the moderately well drained Dorchester soils but differs from them in being more poorly drained and having a moderately dark colored surface soil. Some areas of this soil that are not much above the river level stay wet for fairly long periods. Most of this soil is in permanent pasture.

Peat and muck (Pa, 12).—This unit is composed of partially decayed plant remains. It occupies depressions in the rolling uplands. Muck contains more mineral matter than peat, and the organic matter in it is thoroughly decomposed. Many depressions contain both peat and muck, so mixed that they cannot be separated. These soils are from 3 feet to several feet thick.

Drainage is the first step in reclaiming these soils for crop use. They generally require fertilization for satisfactory yields.

Peat and muck, shallow phases (Pb, 12).—In the shallow phases of peat and muck, the organic matter is from 8 to 36 inches thick. The underlying material is medium to fine textured.

Rough broken land, clayey till (Ra, 13).—This land type occurs along the Minnesota River and some of its larger tributaries. It consists of calcareous clay loam materials similar to those of the Storden soils. It is steep and hilly and is used mostly for permanent pasture rather than for crops. Many areas are wooded, notably one that begins at the northern boundary of the county, near the Minnesota River, and extends downstream to a point near the village of Courtland. Northwest of Courtland the wooded areas are confined largely to the steep slopes along the creeks that flow into the Minnesota River. The unforested slopes support a poor growth of native grasses.

Rough broken land, sandy and gravelly materials (Rb, 13).—This land type is similar to Rough broken land, clayey till, in topographic features but is composed of different soil materials. It occupies slopes bordering the gently undulating sandy and gravelly terraces along the Minnesota River. Usually these areas are grass covered.

Storden-Clarion loams and silt loams, eroded rolling phases (13 to 20 percent slopes) (Sb, 9).—Northeast of Swan Lake are scattered areas where the Clarion and Storden soils are so intricately mixed that it is impossible to map each soil separately. These areas are recognized as a complex of Storden-Clarion loams and silt loams, eroded rolling phases. About 60 percent of the complex is composed of Storden soils, and the remaining 40 percent of Clarion soils. Because of the strong slopes, special care is needed to control erosion.

Storden-Lakeville loams, eroded rolling phases (13 to 20 percent slopes) (Sc, 9).—This complex is similar to the Clarion-Storden-Lakeville loams and silt loams, eroded gently rolling phases, except that the slopes are stronger. There is about an equal distribution of Storden and Lakeville soils in this unit. The characteristics of the Lakeville soil are described on page 16. These are poor agricultural soils, chiefly because of their steep slopes. Pasture is the best use for them.

Storden loam and silt loam, hilly phases (20 percent + slopes) (Sa, 9).—This complex occurs in scattered spots in the uplands near areas of rough broken lands, where there is a sharp drop to the river terraces. The principal areas are near Swan Lake and Courtland. The total acreage is small. The soils are not suitable for cultivated crops.

The surface soil, 6 to 9 inches thick, is very dark brownish-gray granular loam or silt loam. The subsoil is not well developed and is lacking entirely in places. Where it does occur, it is brown loam or silt loam that grades into light yellowish-brown heavy loam or clay loam at depths of 12 to 15 inches. The substratum is strongly calcareous.

The best use for Storden loam and silt loam, hilly phases, is pasture or hay—either alfalfa alone or a mixture of alfalfa and tame grasses. The soils are too hilly for general farm crops.

Terril sandy loam and loam, very gently sloping phases (0 to 3 percent slopes) (Ta, 8).—This mapping unit occupies the slopes between rough broken lands and the bottom lands adjoining the Minnesota River.

The Terril soils are not well developed. The surface soil, 18 to 36 inches thick, is very dark brown granular loam or sandy loam. The subsoil varies. In most places it is a brown loam or sandy loam that gradually becomes lighter colored with increasing depth.

These soils are productive because of their depth and their moderate content of organic matter. Loss of soil through erosion is slight.

Terril sandy loam and loam, gently sloping phases (3 to 7 percent slopes) (Tb, 8).—The surface soil and subsoil of this unit are similar to those of the very gently sloping phases of Terril sandy loam and loam. Some care is required to control erosion.

Terril sandy loam and loam, sloping phases (7 to 13 percent slopes) (Tc, 9).—Except for stronger slopes, these soils are essentially the same as the gently sloping phases of Terril sandy loam and loam. If these sloping phases are used for farm crops, sod crops should be grown for several years in between to control erosion.

Terril silt loam, very gently sloping phase (0 to 3 percent slopes) (Td, 1).—This phase is differentiated from Terril sandy loam and loam, very gently sloping phases, chiefly by the finer texture of the surface soil. Both the surface soil and subsoil are silt loam. This soil is very productive. It has a moderately high water-holding capacity, and because of the gentle slopes only a little water is lost through runoff.

Terril silt loam, gently sloping phase (3 to 7 percent slopes) (Te, 1).—This is the most extensive phase of the Terril series. It is similar to Terril silt loam, very gently sloping phase, except that it has steeper slopes and requires more careful management to control erosion.

Terril silt loam, sloping phase (7 to 13 percent slopes) (Tf, 9).—This phase differs but little from the gently sloping phase. The areas where the slope gradient is nearly 13 percent are near areas of rough broken lands. This is a productive soil that responds to good management. Severe losses of surface soil through erosion are likely if the soil is not well managed.

Volin silt loam, nearly level phase (0 to 3 percent slopes) (Va, 11).—This soil occurs on the Minnesota River bottoms and is associated with the Dorchester soils. The surface soil is very dark brown granular silt loam, 12 to 24 inches deep. The subsoil is grayish-brown silt loam grading into pale-brown silt loam. Beginning at depths of 36 to 48 inches, the subsoil is interbedded in many places with thin bands of sand.

Volin silt loam, nearly level phase, is a very productive soil. It occupies higher positions than other bottom-land soils and is consequently subject to flooding only when the river is unusually high.

Volin silt loam, undulating phase (3 to 7 percent slopes) (VB, 11).—This soil differs from the nearly level phase of Volin silt loam chiefly in having slightly stronger slopes. It is just as productive as the nearly level phase and is used for the same kinds of crops.

Wadena sandy loam, nearly level phase (0 to 3 percent slopes) (WC, 5).—This medium-textured soil occurs on the high terraces bordering the Minnesota River.

The surface soil is very dark brown sandy loam, 10 to 15 inches deep. The subsoil, 20 to 30 inches thick, is reddish-brown loam that breaks abruptly into beds of stratified calcareous gravel and sand. This soil is used for general farm crops, though it tends to be droughty and does not supply adequate moisture during dry weather.

Wadena sandy loam, undulating phase (3 to 7 percent slopes) (WD, 5).—This soil is like Wadena sandy loam, nearly level phase, except for having more pronounced slope that causes more rapid runoff and, consequently, some loss of surface soil through erosion. The soil is somewhat more droughty than the nearly level phase.

Wadena sandy loam, eroded gently rolling phase (7 to 13 percent slopes) (WE, 7).—This phase is limited to small areas near the boundaries of terraces, where the relief is rolling and some erosion has taken place.

The surface soil is very dark grayish-brown sandy loam, 6 to 10 inches thick. The subsoil is reddish-brown loam, which grades rather sharply into calcareous gravelly sand at depths of 24 to 30 inches. This soil must be managed carefully to control erosion, which in some areas has already caused serious damage. The soil is droughty, and yields are generally low.

Wadena loam, nearly level phase (0 to 3 percent slopes) (WA, 6).—This soil occurs in association with the Kasota soils. It has moderately high water-holding capacity. Crops generally do well in years of normal and well-distributed rainfall.

The surface soil is very dark brown granular loam, 10 to 15 inches deep. The subsoil, from 12 to 15 inches, is reddish-brown heavy loam. The calcareous gravelly sand substratum begins abruptly at depths of 22 to 30 inches. Except for its finer textured surface soil and subsoil, Wadena loam is similar to Wadena sandy loam.

Wadena loam, undulating phase (3 to 7 percent slopes) (WB, 6).—Except for slope, this soil is substantially the same as the nearly level phase of Wadena loam.

Webster silty clay loam, nearly level phase (0 to 3 percent slopes) (WF, 3).—This soil, like all the Webster soils, is dark colored, permeable to water, and poorly drained. It was developed from calcareous glacial till under a cover of native wild grasses. For the most part it occurs on nearly level broad flats, or in very slight depressions on the uplands in association with the well-drained Clarion and moderately well drained Nicollet soils. For maximum productivity, this soil and others of its series must be artificially drained. This soil is one of the most extensive in the county; it occurs in every township.

The surface soil, 12 to 36 inches deep, is very dark gray to black granular silty clay loam. This grades into olive-gray silty clay loam subsoil which reaches depths of 24 to 36 inches. Below this is a strongly calcareous light olive-gray loam or clay loam that contains many small lime pebbles.

When drained, this soil is one of the most productive soils in Minnesota for corn and soybeans. It is generally well supplied with organic matter. It has a high water-holding capacity, which enables crops to withstand the short periods of dry weather that are apt to occur in the latter part of the growing season.

Webster silty clay loam, colluvial phase (0 to 3 percent slopes) (WG, 3).—This soil occurs in poorly drained swales in association with the Clarion and Nicollet soils. Where the swales, or water runways, are narrow they are usually not artificially drained, but where they are wide, tile often has been installed to improve drainage.

The surface soil is very dark gray granular silty clay loam, 15 to 30 inches deep. The subsoil is olive-gray clay loam, grading to light olive-gray clay loam at depths of 30 to 40 inches. This is a productive soil, well supplied with organic matter and plant nutrients. It is usually farmed by the same methods as the surrounding areas of better drained soils.

Soil Development and Classification

This section deals with the genesis and morphology of the soils of Nicollet County and their place in the higher categories of soil classification. It is of interest primarily to soil scientists.

Soil development

The morphological and genetical characteristics of soils are the product of five factors of soil formation—climate, vegetation, parent material, topography, and age. Climate and vegetation are the active factors that alter the parent material. The effects of climate and vegetation vary according to the length of time the parent material has been in place, and are modified by topography. Weathering is more rapid in soils that remain moist than in those that dry out.

On gently rolling or undulating uplands, the effect o climate is shown by the depth of weathering. Within th limits of a county, climate does not vary enough to caus any appreciable differences in the soils, but minor changes in climate might be important because of their effect on vegetation.

The influence of vegetation can be seen in the thickness and color of the A horizon. Most of Nicollet County was covered by prairie grasses, which supplied the abundant organic matter that gave the surface soils their dark color.

Except for the valley of the Minnesota River, Nicollet County is covered by a 100- to 400-foot mantle of calcareous, clayey glacial drift deposited by the Wisconsin ice sheet. Boulders of crystalline rock are mixed with the glacial till. The moderately fine texture of this parent material is reflected in the fine to moderately fine texture of the A and B horizons of most of the soils of the county. On the terraces of the Minnesota River, the soils have developed from either calcareous gravelly material or from noncalcareous sandy deposits. On the bottom lands, the soil material was silty or silty clay loam alluvium.

The major morphological differences among the upland soils can be attributed largely to differences in surface relief. Where slopes are gentle, the subsoils are gray and

olive gray; in areas of strong relief, the subsoils are brown to yellowish brown. Topography influences soil development principally through its effects on erosion processes and available water.

The influence of time is seen by comparing the poorly developed profiles in the recently deposited material of the flood plains with better developed profiles in the older and well-drained materials of the uplands. Figure 3 shows the topographic position and slope characteristics of the principal soil series of the county.

Soil classification

Soils of five of the great soil groups were mapped in Nicollet County. The classification of the soil series of the county by the great soil groups, and of the great soil groups by zonal, intrazonal, and azonal orders, is discussed in the pages that follow.

Zonal Soils

Zonal soils have well-developed profile characteristics that reflect the effects of climate and vegetation, the active factors of soil formation. In Nicollet County the zonal order is represented by the Prairie soils.

Prairie soils.—The following soil series mapped in Nicollet County belong to the Prairie great soil group:

Clarion	Le Sueur [1]
Copas	Nicollet
Dickinson	Storden [2]
Hubbard	Terril
Kasota	Volin
Lakeville	Wadena

[1] Intergrade between Prairie and Gray-Brown Podzolic.
[2] Intergrade between Prairie and Regosol.

Prairie soils have formed in a cool, moderately humid climate under a cover of big bluestem (*Andropogon gerardi*), little bluestem (*A. scoparius*), and other native prairie grasses. These soils usually have a very dark brown A horizon, a brown B horizon, and a yellowish-brown C horizon. The moderately well drained Prairie soils are mottled below 18 inches.

Clarion silt loam is representative of the Prairie soils in this county. It has formed from calcareous till of the Mankato substage of the Wisconsin glaciation. The soil profile varies with the degree of slope; it is shallower in the more rolling areas. The following profile description is typical of Clarion silt loam in areas of undulating relief.

- A_1 0 to 6 inches, very dark brown (10YR 2/2) [3] moderate granular, friable silt loam; pH 5.4.[4]
- A_3 6 to 9 inches, dark gray-brown (10YR 4/2), moderate fine subangular blocky, friable silty clay loam; contains some darker streaks and spots; pH 5.2.
- B_1 9 to 14 inches, brown (10YR 4/3), weak fine subangular blocky silty clay loam, plastic when moist; pH 5.0.
- B_2 14 to 33 inches, brown (10YR 5/3), very weak fine subangular blocky, compact clay loam; pH 5.3.
- C_1 33 to 38 inches, brown (10YR 4/3), structureless, compact clay loam with widely scattered rust spots; pH 7.2.
- C_2 38 inches +, yellowish-brown (10YR 5/4), calcareous, structureless, friable clay loam; pH 7.5.

Prairie soils of Nicollet County have many of the characteristics of Clarion silt loam. The Kasota, Wadena and Hubbard soils have developed from outwash material deposited on the terraces. The Kasota are the finest textured, and the Hubbard are the coarsest. The Copas soils have developed from shallow, medium-textured outwash material overlying sandstone or quartzite bedrock. The Dickinson soils are somewhat similar to the Hubbard but occur on the uplands in association with the Clarion soils. The Lakeville soils have developed from limy, sandy, gravelly material in the uplands. On steep slopes, there has developed a soil that lacks a B horizon. This soil is in the Storden series and it is an intergrade to the Regosol great soil group.

[3] Munsell color designation; all designations are for soil when moist.
[4] See Glossary for definition of soil reaction.

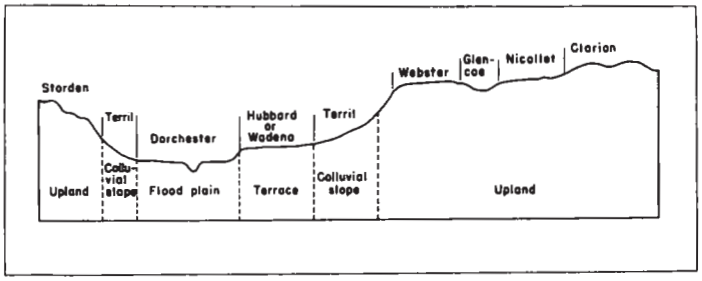

FIGURE 3.—Physiographic position and common slopes of the principal soil series in Nicollet County, Minn.

The Nicollet soil is moderately well drained and somewhat mottled in the B and C horizons. The following profile is typical of Nicollet silty clay loam:

- A_1 0 to 10 inches, black (2.5YR 2/0), moderate granular, friable silty clay loam; pH 5.7.
- A_3 10 to 14 inches, very dark brown (2.5YR 2/0), moderate fine subangular blocky silty clay loam; plastic when moist; pH 5.5.
- B_1 14 to 19 inches, dark gray-brown (2.5YR 4/2), weak fine subangular blocky silty clay loam; plastic when moist; pH 5.3.
- B_2 19 to 29 inches, dark gray-brown (2.5YR 4/2), weak prismatic, compact clay loam; pH 5.5.
- C_1 29 to 32 inches, gray-brown (2.5YR 5/2), mottled with light olive brown (2.5YR 5/6), structureless, friable clay loam; pH 7.3.
- C_2 32 inches +, gray-brown (2.5YR 5/2), calcareous, structureless, friable clay loam; pH 7.6.

The Le Sueur soils have some properties of true, but poorly developed, wooded soils and are an intergrade to Gray-Brown Podzolic. They have a thin A_2 horizon and a well-developed blocky structure in the B horizon, and have been leached of lime to a greater depth than is common in the Nicollet soil. They have been classified as Prairie soils because they more closely resemble soils of that group.

Intrazonal Soils

Intrazonal soils have more or less well developed characteristics that show the dominance of some local factor of relief or parent material over climate and vegetation. The intrazonal soils of Nicollet County are the Humic Gley and the organic soils. The organic soils, not classified as a great soil group, occur in depressions in the uplands. The organic layer ranges from a few inches to several feet thick and is ordinarily underlain by fine-textured mineral material. Organic soils are mapped in two units, Peat and muck, and Peat and muck, shallow phases.

Humic Gley soils.—The following soil series mapped in Nicollet County are in this great soil group:

Blue Earth	Harpster
Faxon	Oshawa
Glencoe	Webster

The Humic Gley soils formed under grass vegetation, where drainage was poor to very poor. These soils usually occupy nearly level depressions. The water table is normally high, and, except where artificially drained, the soils are waterlogged a good part of the year.

Humic Gley soils normally have a very dark gray to black A horizon, a rather abrupt transition to an olive-gray gley (G) horizon, and then a C horizon of strongly mottled olive-gray clay loam. Following is a description of a typical Webster silty clay loam, the most extensive Humic Gley soil in the county.

- A_1 0 to 13 inches, black (5Y 2/1), granular silty clay; sticky when wet; pH 6.6.
- B_1 13 to 16 inches, olive-gray (5Y 4/2), streaked with black, moderate fine subangular blocky silty clay; sticky when wet; pH 6.9.
- BG 16 to 22 inches, olive-gray (5Y 5/2), weak fine subangular blocky silty clay showing a few dark streaks; sticky when wet; pH 7.3.
- C_1 22 to 27 inches, light olive-gray (5Y 6/2), slightly calcareous, structureless silty clay loam; plastic when moist; has a few rust spots; pH 7.5.
- C_2 27 inches +, light olive-gray (5Y 6/2), highly calcareous, structureless, friable silty clay loam; pH 7.6.

The Glencoe soil, usually associated with the Webster soils, is a Humic Gley soil that occupies depressions in the uplands. Harpster soil occupies some of the imperfectly drained upland areas; it has noticeable microrelief and its surface soil is highly calcareous. The Blue Earth soil, which occupies dried-up lake basins, is also highly calcareous at the surface. Faxon soil, the poorly drained associate of the Copas soils, occurs on structural limestone or sandstone benches. The Oshawa, a poorly drained bottom-land soil, is considered a minimal Humic Gley because it has a shallow and poorly developed profile.

Azonal Soils

Azonal soils do not have well-developed profiles. Conditions of parent material, relief, or age, singly or in combination, are such that normal development has been prevented or retarded. The Alluvial soils and the Lithosols are the azonal soils of Nicollet County.

Alluvial soils.—The Cass soil and the Dorchester soils of Nicollet County are in the Alluvial great soil group.

Alluvial soils do not have well-developed profiles because the parent material is constantly changing as fresh sediments are deposited. It does not remain undisturbed long enough for soils to develop. The surface of an Alluvial soil has essentially the same texture as the parent material.

The Dorchester soils are moderately dark colored and medium textured to fine textured and have only slight, if any, profile development. The Cass soil is a dark-colored fine sandy loam and has weak profile development.

Lithosols.—The only Lithosols in Nicollet County are the mapping units of rough broken land that border the Minnesota River. This land has little or no profile development, and bedrock is commonly close to the surface.

Laboratory Determinations

Laboratory analyses were made of three extensive and productive soils in Nicollet County—Clarion silt loam, undulating phase; Nicollet silty clay loam, gently undulating phase; and Webster silty clay loam, nearly level phase. Table 7 gives the results of mechanical analysis of these soils, and table 8, their significant chemical properties.

TABLE 7.—*Mechanical analysis of certain soils of Nicollet County, Minn.*

Soil phase and horizon	Depth	Very coarse sand	Coarse sand	Medium sand	Fine sand	Very fine sand	Total sands	Silt	Clay
Clarion silt loam, undulating phase:	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
A	0– 3	1.2	4.4	4.9	13.7	7.8	32.0	35.4	32.6
	3– 6	1.4	3.9	4.6	14.4	7.7	32.1	35.1	32.8
B	14–20	1.7	3.7	4.3	13.6	9.3	32.8	33.0	34.2
	20–26	1.6	4.4	4.8	15.2	9.6	35.6	33.5	30.9
C	38–44	2.3	5.3	5.2	16.9	10.1	39.8	34.7	25.5
Nicollet silty clay loam, gently undulating phase:									
A	0– 5	1.2	3.6	4.0	10.7	6.9	26.4	41.7	31.9
	5–10	.9	3.1	3.5	9.1	6.2	22.8	44.3	32.9
B	19–24	1.4	4.1	5.0	16.6	10.7	38.0	29.9	32.1
	24–29	1.9	4.3	4.8	15.3	10.1	36.4	31.8	31.8
C	38–44	2.3	4.9	4.6	14.7	10.1	36.7	37.6	25.7
Webster silty clay loam, nearly level phase:									
A	0– 4	1.8	4.7	4.6	10.2	6.0	27.2	38.2	34.6
	4– 8	1.8	3.9	4.1	8.5	6.1	24.4	39.7	35.9
B	13–16	3.4	4.2	3.6	8.1	6.5	25.9	36.7	37.4
	16–19	3.0	5.0	4.4	8.5	6.4	27.3	34.6	38.0
C	27–33	3.1	5.5	4.5	7.6	5.9	26.5	37.4	36.1

TABLE 8.—*Chemical properties of certain soils of Nicollet County, Minn.*

Soil phase and horizon	Depth	pH	Exchangeable cations Me./100 gm.					Base saturation	Organic carbon	C:N ratio
			H	Ca	Mg	K	Total			
Clarion silt loam, undulating phase:	*Inches*							*Percent*	*Percent*	
A	0– 3	5. 5	10. 0	16. 4	6. 0	0. 33	33. 4	68	3. 44	14. 6
	3– 6	5. 4	11. 0	15. 3	6. 4	. 21	33. 0	66	3. 35	13. 9
B	14–20	5. 1	5. 8	13. 8	6. 9	. 08	27. 7	75	. 74	12. 6
	20–26	5. 3	4. 8	13. 0	6. 1	. 07	24. 9	77	. 53	14. 1
C	38–44	7. 5	--------	12. 6	4. 6	. 05	17. 5	100	--------	--------
Nicollet silty clay loam, gently undulating phase:										
A	0– 5	5. 7	10. 0	17. 7	5. 8	. 43	34. 3	70	3. 79	12. 7
	5–10	5. 6	11. 0	17. 0	5. 8	. 21	35. 1	66	3. 59	13. 1
B	19–24	5. 2	4. 4	15. 5	7. 1	. 11	27. 8	82	. 62	11. 8
	24–29	5. 9	3. 6	16. 0	6. 7	. 07	25. 8	88	. 40	10. 7
C	38–44	7. 6	--------	13. 8	4. 5	. 05	18. 4	100	--------	--------
Webster silty clay loam, nearly level										
A	0– 4	6. 5	5. 8	21. 3	10. 3	. 23	38. 2	83	4. 30	15. 3
	4– 8	6. 6	4. 9	21. 0	10. 6	. 26	37. 4	85	3. 77	16. 5
B	13–16	6. 9	2. 3	20. 5	10. 0	. 17	32. 6	94	. 87	18. 9
	16–19	7. 2	--------	18. 1	9. 4	. 09	27. 6	100	--------	--------
C	27–33	7. 5	--------	18. 2	8. 3	. 05	26. 6	100	--------	--------

Glossary

Aggregate. A single mass or cluster consisting of many soil particles; a clod, a crumb, or a granule.

Alluvial soils. A group of soils developed from transported and relatively recently deposited material (alluvium), that has been modified only slightly, or not at all by soil-forming processes. *See also* Alluvium.

Alluvium. Fine material, such as sand, silt, or other sediments, deposited on land by streams.

Arable land. Land that, in its present condition, is physically capable, without further substantial improvement, of producing crops requiring tillage.

Association, soil. A group of soils, with or without characteristics in common, that occur in a distinctive geographical pattern.

Clay. Small mineral soil grains, less than 0.002 mm. (0.000079 inch) in diameter.

Colluvium. Deposits of rock fragments and soil material accumulated at the base of slopes through the combined influences of water and gravity.

Complex. Two or more soil series, types, or phases occurring together in such an intricate pattern or in such small individual areas that they cannot be shown separately on maps of the scale used.

Consistence. The degree of firmness of soil aggregates or of entire soil horizons; that is, the attraction of particles for one another and their resistance to separation or deformation. Descriptive terms used to define consistence are loose, compact, mellow, friable, crumbly, plastic, soft, firm, hard, and cemented.

Cropland. Land regularly used for crops, except forest crops; includes rotation pasture, cultivated summer fallow, or other land ordinarily used for crops but temporarily idle.

Drift, glacial. Rock and earth materials, sorted or unassorted, that have been deposited by glacial ice. *See* Till, glacial.

Fertility. The quality that enables a soil to provide the proper compounds, in the proper quantities and in the proper balance, for the growth of specified plants when other factors, such as light temperature, and the physical condition of the soil, are favorable.

Flood plain. Nearly level land, subject to overflow, along streams.

Friable. Easily crumbled in the fingers; nonplastic. *See* Consistence.

Genesis, soil. The way in which the soil originated, particularly the processes that caused the soil to develop from unconsolidated parent material.

Granular. Roughly spherical aggregates, either hard or soft; usually firmer than a crumb structure and lacking the distinct faces of blocky structure. *See* Structure, soil.

Green-manure crop. Any crop grown and plowed under for the purpose of improving the soil, especially by the addition of organic matter.

Horizon, soil. Layer of soil approximately parallel to the land surface that has more or less well-defined characteristics that have been produced through soil-building processes.

Leaching. Removal of materials in solution.

Morphology. The physical properties of the soil, including the texture, structure, porosity, consistence, color, and thickness of each horizon, and the arrangement of horizons in the profiles.

Mottled (mottling). Irregularly marked with spots of different colors.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. *See* Horizon, soil.

Reaction, soil. Degree of acidity or alkalinity of the soil mass expressed in pH values or words as follows:

Extremely acid	Below 4. 5
Very strongly acid	4. 5–5. 0
Strongly acid	5. 1–5. 5
Medium acid	5. 6–6. 0
Slightly acid	6. 1–6. 5
Neutral	6. 6–7. 3
Mildly alkaline	7. 4–7. 8
Moderately alkaline	7. 9–8. 4
Strongly alkaline	8. 5–9. 0
Very strongly alkaline	9. 1 and higher

Sand. Rock or mineral fragments 0.05 to 1.0 mm. (0.002 to 0.039 inches) in diameter. Also applied to any soil containing 90 percent or more of sand; sand is usually composed chiefly of quartz, but may be made up of any mixture of mineral or rock fragments.

Series, soil. Group of soils having genetic horizons similar as to differentiating characteristics and arrangement in the soil profile, except for the texture of the surface soil, and developed from a particular type of parent material. A series may include two or more soil types differing from one another in the texture of the surface soil. *See* Horizon, soil; Profile, soil; Type.

Silt. Mineral soil grains 0.05 to 0.002 mm.(0.002 to 0.000079 inches) in diameter.

Single grain. Composed of individual soil particles; structureless and noncoherent, as sand.

Soil. A natural body on the surface of the earth in which plants grow; composed of organic and mineral materials.

Soil class. Principal classes, based on relative proportion of soil separates increasing in order of the content of finer separates, are as follows: Sand, loamy sand, sandy loam, loam, silt loam, silty clay loam, clay loam, and clay.

Stripcropping. Growing ordinary farm crops in long strips of variable width, across the line of slope, ap-

proximately on the contour, dense-growing crops and clean-tilled crops being seeded in alternate strips.

Structure, soil. Aggregates in which the individual soil particles are arranged; principal types of structure in this county are crumb, granular, nuciform (blocklike), and platy.

Subsoil. That part of the soil profile commonly below plow depth and above the parent material.

Surface soil. The upper part of arable soils commonly stirred by tillage implements, or an equivalent depth (5 to 8 inches) in nonarable soils.

Terrace, geological. Level or gently undulating land along a stream valley, and intermediate in elevation between the flood plain and the upland.

Texture. Relative proportion of sand, silt, clay, or gravel in the soil.

Till, glacial. Unstratified deposits of earth, sand, gravel, and boulders transported by glaciers. *See* Drift, glacial.

Topography. The configuration of the land surface; the gradient and pattern of slopes.

Type. A group of soils having similar genetic horizons in texture, arrangement, and other characteristics, and developed from a particular kind of parent material.

Important characteristics of the soils

Map symbol	Soil management group	Soil	Dominant slope	Drainage through soil	Moisture-supplying capacity	Erosion hazard
BA	4	Blue Earth silty clay loam	0–3	Slow	High	None
CA	11	Cass fine sandy loam	0–3	Medium	Moderate	None
		Clarion silt loam:				
CB	1	Undulating phase	3–7	Medium	Good	Moderate
CC	1	Eroded undulating phase	3–7	Medium	Good	Moderate
CD	9	Gently rolling phase	7–13	Medium	Good	Moderate
CE	9	Eroded gently rolling phase	7–13	Medium	Good	Moderate
		Clarion-Dickinson loams:				
CF	8	Undulating phases	3–7	Medium	Moderate	Slight
CG	8	Eroded undulating phases	3–7	Medium	Moderate	Moderate
CH	9	Eroded gently rolling phases	7–13	Medium	Moderate	Moderate
CK	8	Clarion-Lakeville loams, eroded undulating phases.	3–7	Rapid	Moderate	Moderate
CL	9	Clarion-Storden loams and silt loams, eroded gently rolling phases.	7–13	Medium	Moderate	Severe
CM	9	Clarion-Storden-Lakeville loams and silt loams, eroded gently rolling phases.	7–13	Rapid	Moderate	Severe
		Copas loam:				
CN	10	Nearly level phase	0–3	Medium	Moderate	None
CO	10	Undulating phase	3–7	Medium	Moderate	Slight
DB	11	Dorchester soils, undifferentiated	0–3	Slow	High	None
DA	11	Dorchester silty clay loam	0–3	Slow	High	None
FA	10	Faxon silty clay loam, deep phase	0–3	Slow	High	None
GA	4	Glencoe silty clay loam	0–3	Slow	High	None
HA	3	Harpster silty clay loam	0–3	Slow	High	None
		Hubbard sandy loam:				
HE	5	Nearly level phase	0–3	Rapid	Low	Slight
HF	5	Eroded undulating phase	3–7	Rapid	Low	Slight
HG	7	Eroded gently rolling phase	7–13	Rapid	Low	Moderate
		Hubbard loamy sand:				
HB	5	Eroded nearly level phase	0–3	Rapid	Very low	Severe
HC	5	Eroded undulating phase	3–7	Rapid	Very low	Severe
HD	7	Eroded gently rolling phase	7–13	Rapid	Very low	Severe
		Kasota silt loam:				
KA	6	Nearly level phase	0–3	Medium	Good	None
KB	6	Undulating phase	3–7	Medium	Moderate	Slight
		Le Sueur silty clay loam:				
LA	2	Gently undulating phase	0–3	Moderately slow	High	None
LB	2	Undulating phase	3–7	Moderately slow	High	Slight
MA	13	Marsh		Normally under water.		
MB	11	Mixed alluvium				
NA	2	Nicollet silty clay loam, gently undulating phase.	0–3	Moderately slow	High	None
OA	11	Oshawa silty clay loam	0–3	Slow	High	None
PA	12	Peat and muck		Moderately slow	High	None
PB	12	Shallow phases		Moderately slow	High	None
		Rough broken land:				
RA	13	Clayey till		Medium	Moderate	Severe
RB	13	Sandy and gravelly materials		Rapid	Very low	Severe
SB	9	Storden-Clarion loams and silt loams, eroded rolling phases.	13–20	Medium	Moderate	Severe
SC	9	Storden-Lakeville loams, eroded rolling phases	13–20	Rapid	Moderate	Severe
SA	9	Storden loam and silt loam, hilly phases	20+	Medium	Moderate	Severe
		Terril sandy loam and loam:				
TA	8	Very gently sloping phases	0–3	Medium	Good	Slight
TB	8	Gently sloping phases	3–7	Medium	Good	Moderate
TC	9	Sloping phases	7–13	Medium	Moderate	Moderate
		Terril silt loam:				
TD	1	Very gently sloping phase	0–3	Medium	High	Slight
TE	1	Gently sloping phase	3–7	Medium	Good	Moderate
TF	9	Sloping phase	7–13	Medium	Good	Moderate
		Volin silt loam:				
VA	11	Nearly level phase	0–3	Slow	High	None
VB	11	Undulating phase	3–7	Slow	High	None
		Wadena sandy loam:				
WC	5	Nearly level phase	0–3	Rapid	Low	Slight
WD	5	Undulating phase	3–7	Rapid	Low	Slight
WE	7	Eroded gently rolling phase	7–13	Rapid	Low	Moderate
		Wadena loam:				
WA	6	Nearly level phase	0–3	Rapid	Moderate	None
WB	6	Undulating phase	3–7	Rapid	Moderate	Slight
		Webster silty clay loam:				
WF	3	Nearly level phase	0–3	Slow	High	None
WG	3	Colluvial phase	0–3	Slow	Good	None

of Nicollet County, Minnesota

Parent material	Organic matter	Flood hazard	Productivity	Reaction	
				Surface soil	Subsoil
Lacustrine silt and clay	High	Severe	Moderate	Alkaline	Alkaline.
Coarse alluvium	Moderate	Moderate	Moderate	Neutral	Neutral.
Glacial till	High	None	High	Slightly acid	Alkaline.
Glacial till	Moderate	None	Moderate	Slightly acid	Alkaline.
Glacial till	Moderate	None	Moderate	Slightly acid	Alkaline.
Glacial till	Moderate	None	Moderate	Slightly acid	Alkaline.
Glacial till and sandy glacial drift	Moderate	None	Moderate	Acid	Neutral.
Same	Moderate	None	Moderate	Acid	Neutral.
Same	Moderate	None	Moderate	Acid	Neutral.
Glacial till and sandy, gravelly glacial drift.	Low	None	Moderate	Neutral	Alkaline.
Glacial till	Low	None	Low	Slightly acid	Alkaline.
Glacial till and sandy, gravelly glacial drift.	Low	None	Low	Slightly acid	Alkaline.
Outwash	Moderate	None	Low	Acid	Acid.
Outwash	Moderate	None	Low	Acid	Acid.
Alluvium	Moderate	Severe	Moderate	Alkaline	Alkaline.
Alluvium	Moderate	Severe	High	Alkaline	Alkaline.
Outwash	High	Moderate	Low	Alkaline	Alkaline.
Glacial till	High	Severe	Moderate	Alkaline	Alkaline.
Glacial till	High	None	Moderate	Alkaline	Alkaline.
Sandy outwash	Moderate	None	Low	Acid	Acid.
Sandy outwash	Moderate	None	Low	Acid	Acid.
Sandy outwash	Low	None	Low	Acid	Acid.
Sandy outwash	Low	None	Very low	Acid	Acid.
Sandy outwash	Low	None	Very low	Acid	Acid.
Sandy outwash	Low	None	Very low	Acid	Acid.
Silty outwash over sandy outwash	High	None	High	Acid	Alkaline.
Silty outwash over sandy outwash	Moderate	None	High	Acid	Alkaline.
Glacial till	High	None	Very high	Slightly acid	Alkaline.
Glacial till	High	None	Very high	Slightly acid	Alkaline.
		Severe	Low		
Glacial till	High	None	Very high	Slightly acid	Alkaline.
Alluvium	High	Severe	Low	Alkaline	Alkaline.
Organic material	High	Severe	Low		
Organic material	High	Severe	Low		Alkaline.
Glacial till	Moderate	None	Very low	Slightly acid	Alkaline.
Sandy-gravelly outwash	Low	None	Very low	Acid	Alkaline.
Glacial till	Low	None	Low	Slightly acid	Alkaline.
Glacial till and sandy gravelly glacial drift.	Low	None	Very low	Neutral	Alkaline.
Glacial till	Low	None	Very low	Slightly acid	Alkaline.
Colluvium	Moderate	None	High	Slightly acid	Neutral
Colluvium	Moderate	None	High	Slightly acid	Neutral.
Colluvium	Moderate	None	Moderate	Slightly acid	Neutral.
Colluvium	High	None	Very high	Slightly acid	Neutral.
Colluvium	High	None	High	Slightly acid	Neutral.
Colluvium	High	None	Moderate	Slightly acid	Neutral.
Alluvium	High	Moderate	High	Neutral	Alkaline.
Alluvium	High	Moderate	High	Neutral	Alkaline.
Gravelly outwash	Moderate	None	Moderate	Acid	Alkaline.
Gravelly outwash	Moderate	None	Moderate	Acid	Alkaline.
Gravelly outwash	Low	None	Low	Acid	Alkaline.
Gravelly outwash	Moderate	None	Moderate	Acid	Alkaline.
Gravelly outwash	Moderate	None	Moderate	Acid	Alkaline.
Glacial till	High	None	Very high	Slightly acid	Alkaline.
Glacial till	High	None	Very high	Neutral	Alkaline.

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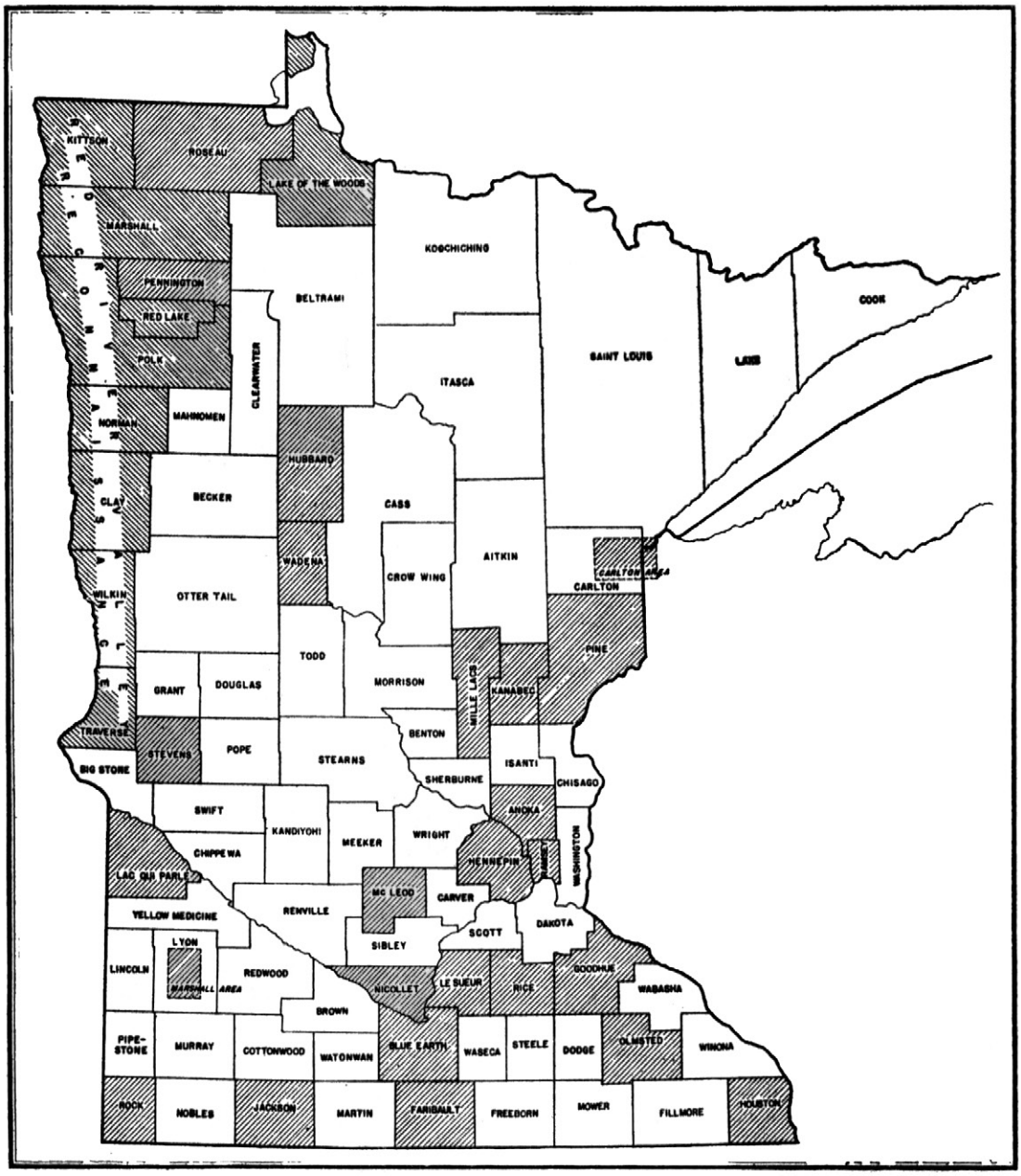

Areas surveyed in Minnesota shown by shading.

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Washington, D.C. 20250-9410;

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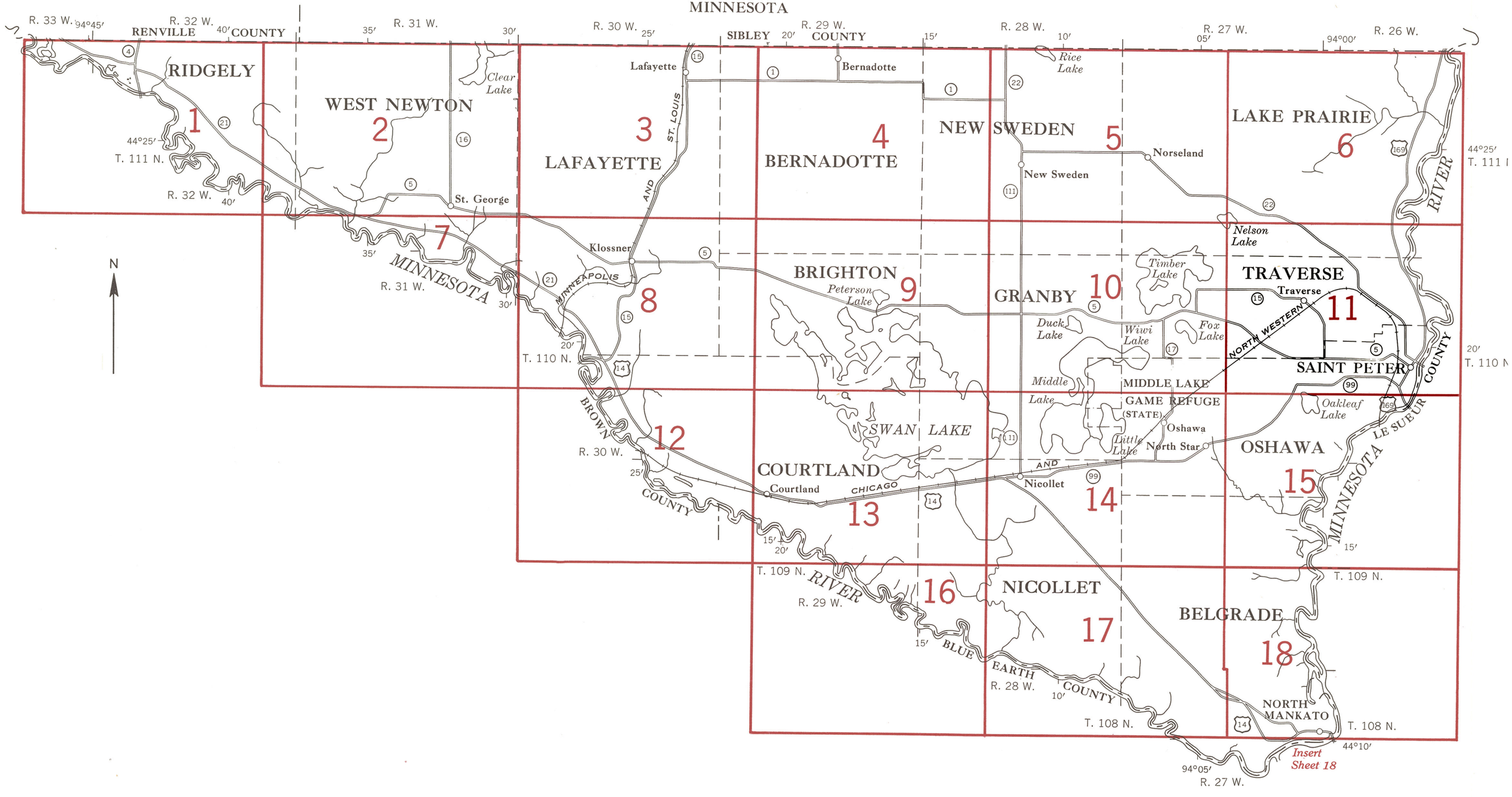
INDEX TO MAP SHEETS

NICOLLET COUNTY
MINNESOTA



NICOLLET COUNTY, MINNESOTA

SOIL LEGEND

SYMBOL	NAME	MANAGEMENT GROUP
Ba	Blue Earth silty clay loam	4
Ca	Cass fine sandy loam	11
Cb	Clarion silt loam, undulating phase	1
Cc	Clarion silt loam, eroded undulating phase	1
Cd	Clarion silt loam, gently rolling phase	9
Ce	Clarion silt loam, eroded gently rolling phase	9
Cf	Clarion-Dickinson loams, undulating phases	8
Cg	Clarion-Dickinson loams, eroded undulating phases	8
Ch	Clarion-Dickinson loams, eroded gently rolling phases	9
Ck	Clarion-Lakeville loams, eroded undulating phases	8
Cl	Clarion-Storden loams and silt loams, eroded gently rolling phases	9
Cm	Clarion-Storden-Lakeville loams and silt loams, eroded gently rolling phases	9
Cn	Copas loam, nearly level phase	10
Co	Copas loam, undulating phase	10
Da	Dorchester silty clay loam	11
Db	Dorchester soils, undifferentiated	11
Fa	Faxon silty clay loam, deep phase	10
Ga	Glencoe silty clay loam	4
Ha	Harpster silty clay loam	3
Hb	Hubbard loamy sand, eroded nearly level phase	5
Hc	Hubbard loamy sand, eroded undulating phase	5
Hd	Hubbard loamy sand, eroded gently rolling phase	7
He	Hubbard sandy loam, nearly level phase	5
Hf	Hubbard sandy loam, eroded undulating phase	5
Hg	Hubbard sandy loam, eroded gently rolling phase	7
Ka	Kasota silt loam, nearly level phase	6
Kb	Kasota silt loam, undulating phase	6
La	Le Sueur silty clay loam, gently undulating phase	2
Lb	Le Sueur silty clay loam, undulating phase	2
Ma	Marsh	13
Mb	Mixed alluvium	11
Na	Nicollet silty clay loam, gently undulating phase	2
Oa	Oshawa silty clay loam	11
Pa	Peat and muck	12
Pb	Peat and muck, shallow phases	12
Ra	Rough broken land, clayey till	13
Rb	Rough broken land, sandy and gravelly materials	13
Sa	Storden loam and silt loam, hilly phases	9
Sb	Storden-Clarion loams and silt loams, eroded rolling phases	9
Sc	Storden-Lakeville loams, eroded rolling phases	9
Sd	Storden-Lakeville loams, hilly phases	9
Ta	Terril sandy loam and loam, very gently sloping phases	8
Tb	Terril sandy loam and loam, gently sloping phases	8
Tc	Terril sandy loam and loam, sloping phases	9
Td	Terril silt loam, very gently sloping phase	1
Te	Terril silt loam, gently sloping phase	1
Tf	Terril silt loam, sloping phase	9
Va	Volin silt loam, nearly level phase	11
Vb	Volin silt loam, undulating phase	11
Wa	Wadena loam, nearly level phase	6
Wb	Wadena loam, undulating phase	6
Wc	Wadena sandy loam, nearly level phase	5
Wd	Wadena sandy loam, undulating phase	5
We	Wadena sandy loam, eroded gently rolling phase	7
Wf	Webster silty clay loam, nearly level phase	3
Wg	Webster silty clay loam, colluvial phase	3

COLOR LEGEND

GROUP 1
WELL-DRAINED, MEDIUM-TEXTURED SOILS OF THE UNDULATING UPLANDS AND GENTLE COLLUVIAL SLOPES

Cb Clarion silt loam, undulating phase
Cc Clarion silt loam, eroded undulating phase
Td Terril silt loam, very gently sloping phase
Te Terril silt loam, gently sloping phase

GROUP 2
MODERATELY WELL-DRAINED, MODERATELY FINE-TEXTURED SOILS OF THE UPLANDS ON GENTLE SLOPES

La Le Sueur silty clay loam, gently undulating phase
Lb Le Sueur silty clay loam, undulating phase
Na Nicollet silty clay loam, gently undulating phase

GROUP 3
POORLY DRAINED, MODERATELY FINE-TEXTURED SOILS OF THE UPLANDS ON VERY GENTLE SLOPES

Ha Harpster silty clay loam
Wf Webster silty clay loam, nearly level phase
Wg Webster silty clay loam, colluvial phase

GROUP 4
POORLY DRAINED, DARK-COLORED, MODERATELY FINE-TEXTURED SOILS OF UPLAND DEPRESSIONS

Ba Blue Earth silty clay loam
Ga Glencoe silty clay loam

GROUP 5
WELL-DRAINED, MODERATELY COARSE-TEXTURED AND COARSE-TEXTURED SOILS OF THE TERRACES ON GENTLE SLOPES

Hb Hubbard loamy sand, eroded nearly level phase
Hc Hubbard loamy sand, eroded undulating phase
He Hubbard sandy loam, nearly level phase
Hf Hubbard sandy loam, eroded undulating phase
Wc Wadena sandy loam, nearly level phase
Wd Wadena sandy loam, undulating phase

GROUP 6
WELL-DRAINED, MEDIUM-TEXTURED SOILS OF THE TERRACES ON GENTLE SLOPES

Ka Kasota silt loam, nearly level phase
Kb Kasota silt loam, undulating phase
Wa Wadena loam, nearly level phase
Wb Wadena loam, undulating phase

GROUP 7
EXCESSIVELY DRAINED, MODERATELY COARSE-TEXTURED AND COARSE-TEXTURED SOILS OF THE TERRACES ON MODERATE SLOPES

Hd Hubbard loamy sand, eroded gently rolling phase
Hg Hubbard sandy loam, eroded gently rolling phase
We Wadena sandy loam, eroded gently rolling phase

GROUP 8
WELL-DRAINED, MEDIUM-TEXTURED AND MODERATELY COARSE-TEXTURED SOILS OF THE UNDULATING UPLANDS AND GENTLE COLLUVIAL SLOPES

Cf Clarion-Dickinson loams, undulating phases
Cg Clarion-Dickinson loams, eroded undulating phases
Ck Clarion-Lakeville loams, eroded undulating phases
Ta Terril sandy loam and loam, very gently sloping phases
Tb Terril sandy loam and loam, gently sloping phases

GROUP 9
WELL-DRAINED, MEDIUM-TEXTURED AND COARSE-TEXTURED SOILS OF THE UPLANDS ON MODERATE AND STEEP SLOPES

Cd Clarion silt loam, gently rolling phase
Ce Clarion silt loam, eroded gently rolling phase
Ch Clarion-Dickinson loams, eroded gently rolling phases
Cl Clarion-Storden loams and silt loams, eroded gently rolling phases
Cm Clarion-Storden-Lakeville loams and silt loams, eroded gently rolling phases
Sa Storden loam and silt loam, hilly phases
Sb Storden-Clarion loams and silt loams, eroded rolling phases
Sc Storden-Lakeville loams, eroded rolling phases
Sd Storden-Lakeville loams, hilly phases
Tc Terril sandy loam and loam, sloping phases
Tf Terril silt loam, sloping phase

GROUP 10
WELL-DRAINED AND IMPERFECTLY DRAINED, MEDIUM-TEXTURED AND MODERATELY FINE-TEXTURED SOILS OVERLYING BEDROCK WITHIN 36 INCHES ON GENTLE SLOPES

Cn Copas loam, nearly level phase
Co Copas loam, undulating phase
Fa Faxon silty clay loam, deep phase

GROUP 11
SOILS OF THE FLOOD PLAINS

Ca Cass fine sandy loam
Da Dorchester silty clay loam
Db Dorchester soils, undifferentiated
Mb Mixed alluvium
Oa Oshawa silty clay loam
Va Volin silt loam, nearly level phase
Vb Volin silt loam, undulating phase

GROUP 12
ORGANIC SOILS

Pa Peat and muck
Pb Peat and muck, shallow phases

GROUP 13
MISCELLANEOUS NONARABLE LAND TYPES

Ma Marsh
Ra Rough broken land, clayey till
Rb Rough broken land, sandy and gravelly materials

Soils surveyed 1947-48 by H. F. Arneman, in Charge, B. L. Brage, Wallace Nelson, Lowell Hanson, M. G. Evenson, George Whalen, University of Minnesota Agricultural Experiment Station, and L. C. Lamison, U. S. Department of Agriculture. Correlation by I. J. Nygard, U. S. Department of Agriculture.

Soil map constructed by Cartographic Division, Soil Conservation Service, USDA, from 1938 aerial photographs.
Map based on polyconic projection, 1927 North American datum.

NICOLLET COUNTY, MINNESOTA

R.33W. | R.32W.

RENVILLE CO

BROWN CO

MINNESOTA

RIVER

FORT RIDGELY STATE MEMORIAL PARK

RIDGELY

School No 15

T.111N.

(Sheet 2)

N

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

RENVILLE CO | SIBLEY CO

R.32W. | R.31W.

T.111N.

(Sheet 1) | (Sheet 3)

(Sheet 7)

School No 67

School No 62

School No 47

School No 16

WESTON

St George

MINNESOTA RIVER

BROWN CO

0 ½ 1 Mile

Scale 1:31680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

SIBLEY CO

R.30W. | R.29W.

3

N

Lafayette

School No 66

School No 53

School No 51

ST LOUIS AND MINNEAPOLIS

L A F A Y E T T E

B E A N

T.111N.

(Sheet 2)

(Sheet 4)

(Sheet 8)

0 ½ 1 Mile

Scale 1:31680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

SIBLEY CO

R.29W. | R.28W.

4

N

Bernadotte

School No 64

School No 26

School No 37

School No 65

School No 43

BERNADOTTE

NEW ERA

T.111N.

(Sheet 3)

(Sheet 5)

(Sheet 9)

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

R.28W. | R.27W.

SIBLEY CO

5

N

RICE LAKE

School No 13

School No 6

New Sweden

Norseland

Sand Lake

Annexstad Lake

N E W S W E D E N

L A K E P R A I R I E

T.111N.

(Sheet 4)

(Sheet 6)

(Sheet 10)

0 ½ 1 Mile Scale 1:31 680 0 5000

NICOLLET COUNTY, MINNESOTA

(6)

R.27W. | R.26W.

SIBLEY CO

N

T.111N.

(Sheet 5)

(Sheet 11)

LAKE PRAIRIE

School No 5

LE SUEUR CO

RIVER

MINNESOTA

0 ½ 1 Mile

Scale 1:31 680

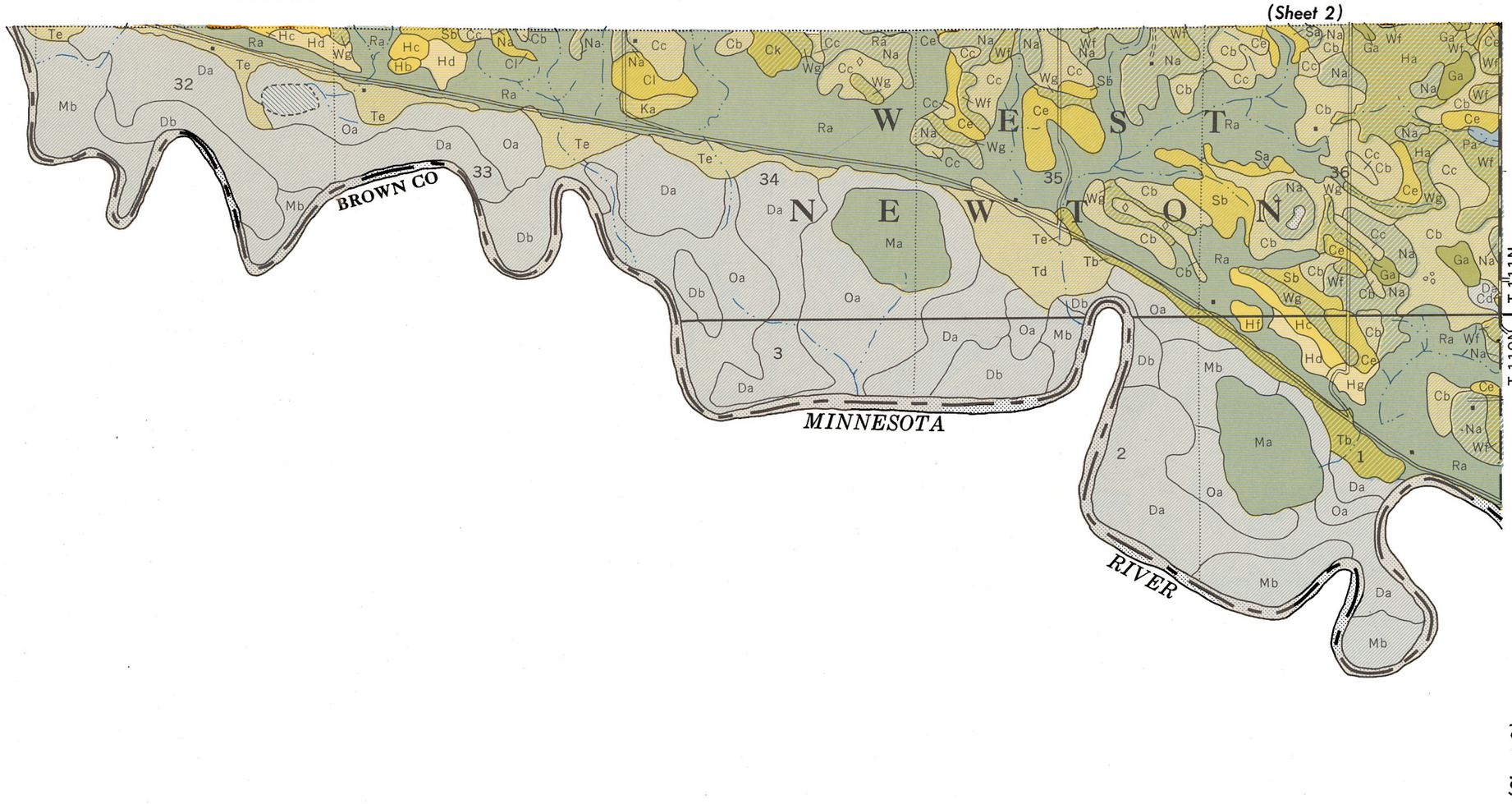
0 5000 Feet

NICOLLET COUNTY, MINNESOTA

R.32W. | R.31W.

(Sheet 2)

7



(Sheet 8)

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

(8)

N

(Sheet 3)

R.30W. | R.29W.

T.110N. T.111N.

(Sheet 7)

(Sheet 9)

(Sheet 12)

BERNADOTTE

Klossner

School No 56

LAFAYETTE

BROWN CO

MINNESOTA

MINNEAPOLIS AND ST LOUIS

COURTLAND

BIRGHO

BERN

RIVER

Ox Bow Lakes

0 ½ 1 Mile

Scale 1:31680

0 5000 Feet

R.29W. R.28W.

(Sheet 4)

N

T.111N.

T.110N.

B E R N A D O T T E

S W E D E N

B R I G H T O N

G R A N B Y

C O U R T L A N D

SWAN LAKE

Peterson Lake

School No 31

School No 59

School No 39

BRIGHTON CEMETERY

(Sheet 8)

(Sheet 10)

(Sheet 13)

0 ½ 1 Mile

Scale 1:31680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

(10)

(Sheet 5)

R.28W. R.27W.

T.110N. T.111N.

N

N E W S W E D E N

L A K E P R A I R I E

T R A V E R S E

G R A N B Y

O S H A W A

MIDDLE LAKE

LAKE WIWI

MIDDLE LAKE GAME REFUGE

School No 30

School No 49

Middle Lake Church

(Sheet 9)

(Sheet 11)

(Sheet 14)

0 ½ 1 Mile

Scale 1:31680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

R.27W. | R.26W.

(Sheet 6)

11

N

T.111N. | T.110N.

(Sheet 10)

LAKE PRAIRIE

TRAVERSE

ROSE

OSHAWA

ST PETER

LE SUEUR CO

MINNESOTA RIVER

NORTH AND WESTERN

CHICAGO

GRAVEL PIT

GUSTAVUS ADOLPHUS COLLEGE

Traverse

(Sheet 15)

0 ½ 1 Mile

Scale 1:31680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

(12)

N

(Sheet 8)

R.30W. | R.29W.

T.109N. | T.110N.

(Sheet 13)

C O U R T L A N D

School No 28

Courtland

MINNESOTA RIVER

CHICAGO AND NORTH WESTERN

BROWN CO

BLUE EARTH CO

0 ½ 1 Mile

Scale 1:31,680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

R.29W. | R.28W.

(Sheet 9)

13

N

G R A N B Y

S W A N L A K E

C O U R T L A N D

N I C O L L E T

Courtland

School No 54

CHICAGO AND NORTH WESTERN

MINNESOTA

BLUE EARTH CO

RIVER

T.110N.

T.109N.

(Sheet 12)

(Sheet 14)

(Sheet 16)

0 ½ 1 Mile

Scale 1:31680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

(14)

(Sheet 10)

R.28W. | R.27W.

N

GRANBY

MIDDLE LAKE GAME REFUGE

RES BDY

Middle Lake

Little Lake

Swan Lake

Oshowa

WESTERN

OSHAWA

North Star

NORTH

CHICAGO AND

Nicollet

ST PAULS CEMETERY

School No 29

NICOLLET

BELGRADE

(Sheet 13)

(Sheet 15)

T.109N. | T.110N.

(Sheet 17)

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

R.27W. | R.26W.

(Sheet 11)

15

N

T.109N. | T.110N.

(Sheet 14)

Oak Leaf Lake

OSHAWA

School No 27

School No 9

BELGRADE

ST PETER

LE SUEUR CO

RIVER

MINNESOTA

LE SUEUR CO

(Sheet 18)

0 ½ 1 Mile

Scale 1:31680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA

(16)

N

(Sheet 13)

R.29W. | R.28W.

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

R.28W. R.27W.

(Sheet 14)

N

(Sheet 18)

T.109N.

T.108N.

(Sheet 16)

N I C O L L E T

B E L L G R A D E

Swan Lake Outlet

HEBRON CEM

Kerns

School No 8

OAK GROVE CEM

Minnewaukon Falls

Minnimishinona Falls

BLUE EARTH CO

MINNESOTA

RIVER

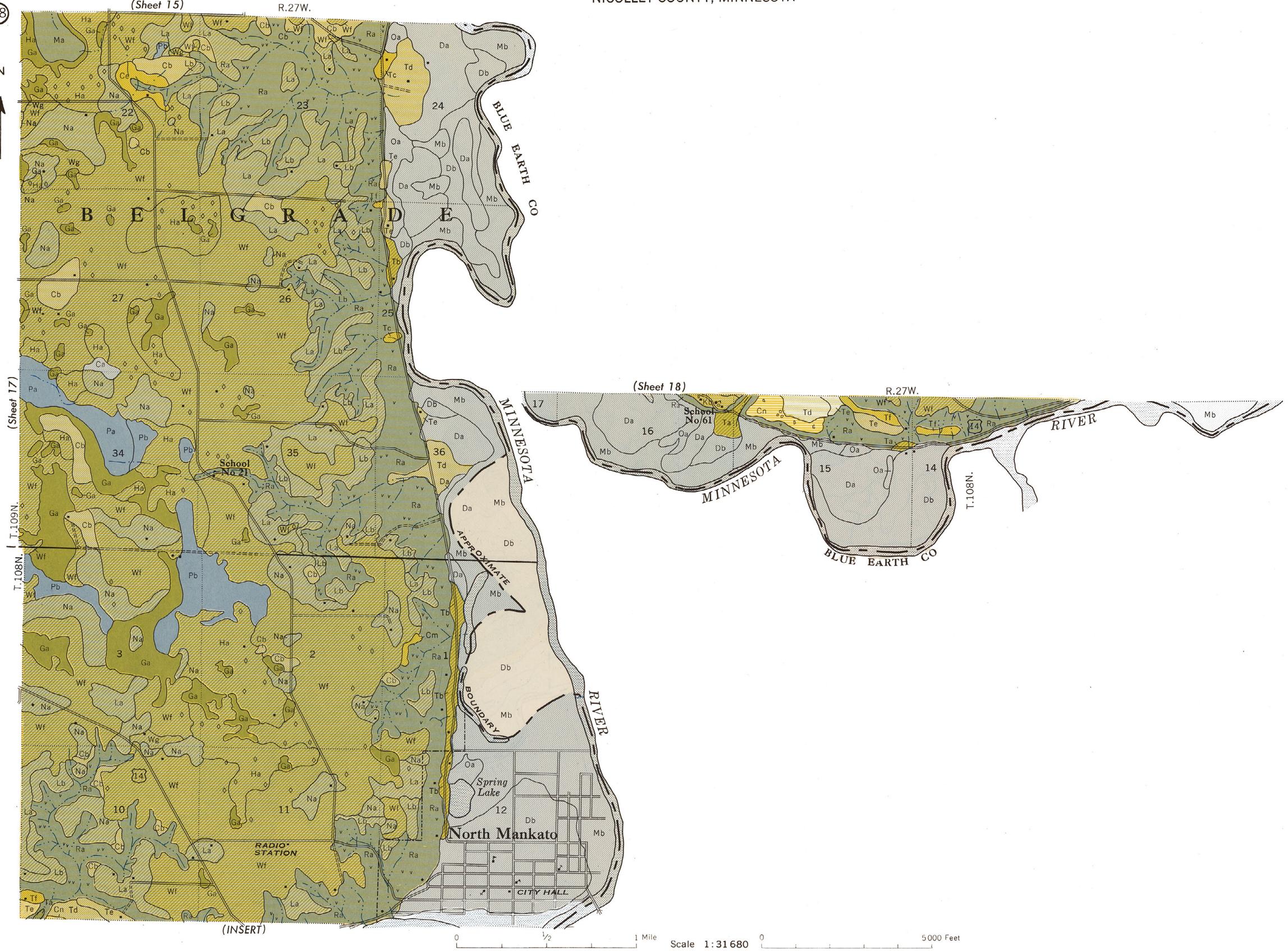
(Sheet 18)

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

NICOLLET COUNTY, MINNESOTA



CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Roads

- Good motor
- Poor motor
- Trail
- Marker, U. S. — 33

Railroads

- Single track
- Multiple track
- Abandoned

Bridges and crossings

- Road
- Trail, foot
- Railroad
- Ferry
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings

- School
- Church
- Station

Mine and Quarry

- Shaft
- Dump
- Prospect

Pits, gravel or other

Power line

Pipeline

Cemetery

Dam

Levee

Tank

Oil well

Windmill

Canal lock (point upstream)

BOUNDARIES

- National or state
- County
- Township, civil
- U. S.
- Section
- City (corporate)
- Reservation
- Land grant

DRAINAGE

Streams

- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements

Canals and ditches — CANAL / DITCH

Lakes and ponds

- Perennial
- Intermittent

Wells — flowing

Springs

Marsh

Wet spot

RELIEF

Escarpments

- Bedrock
- Other

Prominent peaks

Depressions — Large / Small

SOIL SURVEY DATA

Soil type outline and symbol — Dx

Gravel

Stones

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Erosion

- Uneroded spot — U
- Sheet, moderate — S
- Sheet, severe — SS
- Gully, moderate — G
- Gully, severe — GG
- Sheet and gully, moderate — SG
- Wind, moderate
- Wind, severe
- Blowout
- Wind hummock
- Overblown soil

Gullies

Areas of alkali and salts

- Strong — A
- Moderate — M
- Slight — S

Free of toxic effect — F

Sample location — ● 26

Saline spot